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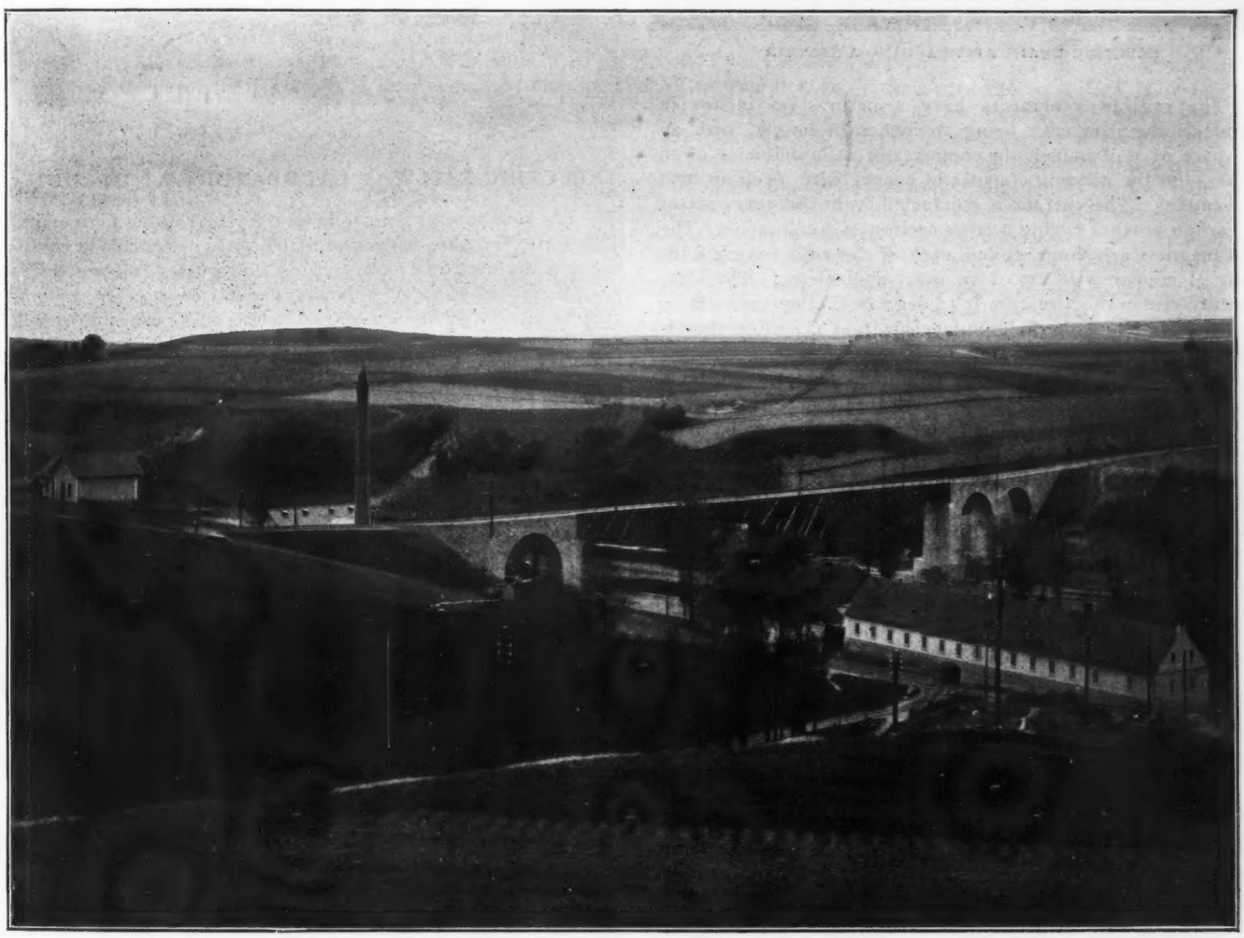
The Tabor-Bechyne Electric Railway

In Europe, as well as in America, many steam railway lines are being converted into electric roads. The short branch steam lines are naturally the first to utilize electric traction on account of the competition of suburban and interurban electric trolley roads.

The details of construction and the electrical equipment of the Tabor-Bechyne electric railway are of much interest at the present time. This road has recently been equipped by the Elektrotechnische Fabrik Fr. Krizik of Fraha-Karlin, and is 15 miles in length, and the smallest curve has a radius of 500 feet. The trains are not operated on the curves at a speed exceeding 10 miles per hour, the normal speed being 20 miles per hour. The heaviest grade is about 35 per cent, and the motor cars haul two or more passenger or freight cars of 36 tons weight.

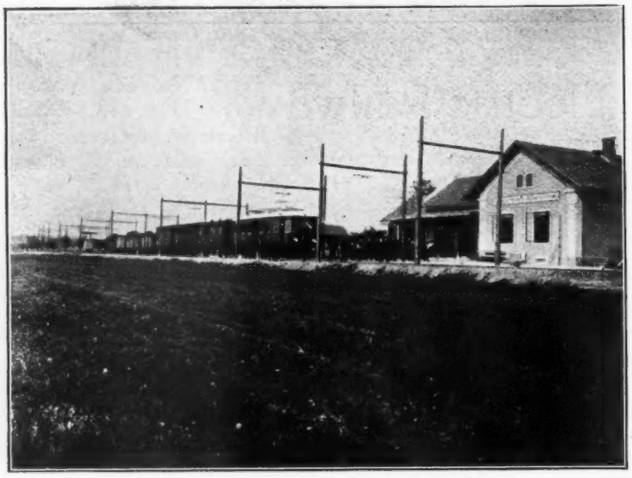
The current is supplied for operating this railway from a central station, which also supplies current for lighting the city of Tabor. The voltage utilized on the trolley is from 600 to 750 volts on each track, the three-wire system being employed for operation, with a total pressure of 1,400 volts between the two outer wires and half this voltage between either conductor and the neutral.



BRIDGE CONSTRUCTION ON THE LINE OF THE ELECTRIC RAILWAY

The station is equipped with vertical compound engines of the condensing type, constructed by the Aktien Gesellschaft, formerly Breitfeld, Danek & Co. of Karolinenthal. These engines each have a capacity of 120 horsepower and operated at a speed of 220 revolutions per minute. The engines are belted to the generators, the capacity of each being 80 kilowatts, at a speed of 500 revolutions per minute. These ma-

chines are of the double pole type, each supplying 700 volts, connected in pairs and operating on the three-wire system at 1,400 volts. They are operated in connection with a storage battery installation of 700 Tudor elements, each having a capacity of from 123 to 171 ampere hours at a one-hour discharge rate.

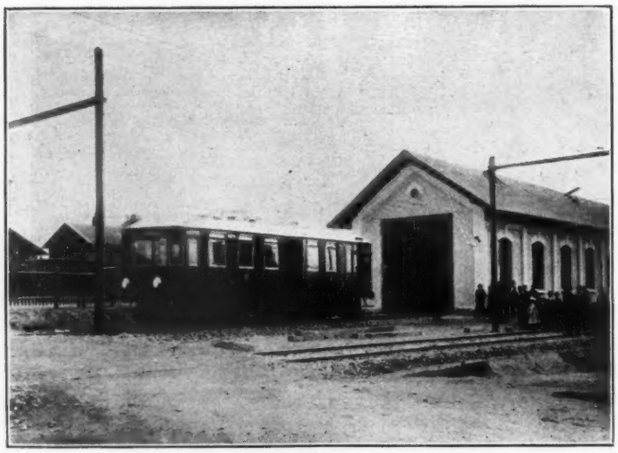


ELECTRIC TRAIN APPROACHING A STATION

The railway generators have armatures 30 inches in diameter, the iron core being 20 inches in length, with an air space of .6 of an inch, the commutator has a diameter of 20 inches, and the winding consists of copper wire .14 of an inch in diameter. The current is conducted from the commutator by carbon brushes having a cross section of .6x1.4 inches. The field magnets are shunt wound, each of the coils having 8,500 turns of copper wire .05 of an inch in diameter. The temperature rise in the armature is 52 degrees C., the commutator 40 degrees C., and the field coils 44 degrees C., while the efficiency is 91 per cent.

In this plant there are two double generator sets on a common base with one set of bearings, the armature being 14 inches in diameter, with an air space of .5 of an inch. The two armatures are of the ring construction, having 720 turns of two wires in parallel, the diameter being .1 of an inch. The commutator is 6¼ inches in diameter, with 60 segments, and two sets of brushes are employed with a cross section of .6x1.3 inches. This double generator set has separate field coils, each having 102 turns of copper wire .3 of an inch.

These machines are also belt driven and supply a current of 2x116 volts, being utilized as boosters, and operate in connection with the storage battery equipment. In the central power station the multipolar machines are used for lighting purposes and are also driven by belt transmission from the vertical compound engines.



THE COMPLETE MOTOR CAR

The motor cars are of the four-axle type with four motors, each having a capacity of 30 horsepower. They take 40 amperes at 640 volts each and operate at a speed of 550 revolutions per minute. These motors have field magnet coils wound with 190 turns of copper conductor .15 of an inch in diameter, the armature windings consisting of 968 turns of copper wires .1 of an ich in diameter and wound 16 wires per slot. The armature is provided with 61 slots, each .35 of an inch wide and 1.3 inches deep, and there is an air space of .15 of an inch. The motors are provided with commutators of 121 segments with two sets of brushes of carbon, with a section .6x1 inch. The temperature rise in the armature is 35 degrees C., the commutator 45 degrees C., and the field exciting coils 41 degrees C.

The motor cars weigh complete 18.8 tons, and without the electrical equipment 13.5 tons, the latter weighing 5.3 tons. These cars each carry passengers third class in the non-smoking compartment, and ten passengers in the smoking compartment of the same class. They also have a seating capacity for ten passengers in the smoking and non-smoking compartments for second class travelers.

The cars are 12 feet 3 inches wide and 41 feet 3 inches long, with a total height of about 13 feet from the top of the car to the track level. The speed of the motor cars is from 15 to 18 miles per hour, and they are equipped with electromagnetic brakes, as well as the usual hand and air brakes.

ELECTRIC RAILWAY LABORATORY AT PURDUE.

The new interurban-car laboratory of Purdue University, Lafayette, Ind., has been completed, and the extensive equipment to be used in testing large electric cars and motors is now in readiness for use during the fall term. The laboratory is in a large brick addition to the electrical engineering building and is built to conform to the main building. Inside there is a large lecture room, overhead cranes strong enough to pick up an entire care and convey it to any portion of the basement, and a large pit in the basement, enabling the students to work beneath the car as it stands on the rails. The tracks leading into the building are connected with the steam railroad, affording direct connection into the laboratory.

Purdue University is the first school to take up the study of electric cars in such an exhaustive manner. The lecture room will seat more than 300 students, and the tracks and overhead cranes are so arranged that entire cars or sections of the motors and other apparatus can be carried directly into the lecture room from the laboratory and be exhibited to the students. The motors and other apparatus can also be brought into the lecture room and placed on large demonstration tables, where electrical connections enable the professor in charge to operate the piece of machinery as he lemonstrates it before the students.

NORTHERN ELECTRIC LINE OPEN.

The first electric car was run over the Northern Electric Suburban road from Chico to Yuba City on the afternoon of November 1st. It is expected that regular service will be established in about two weeks.

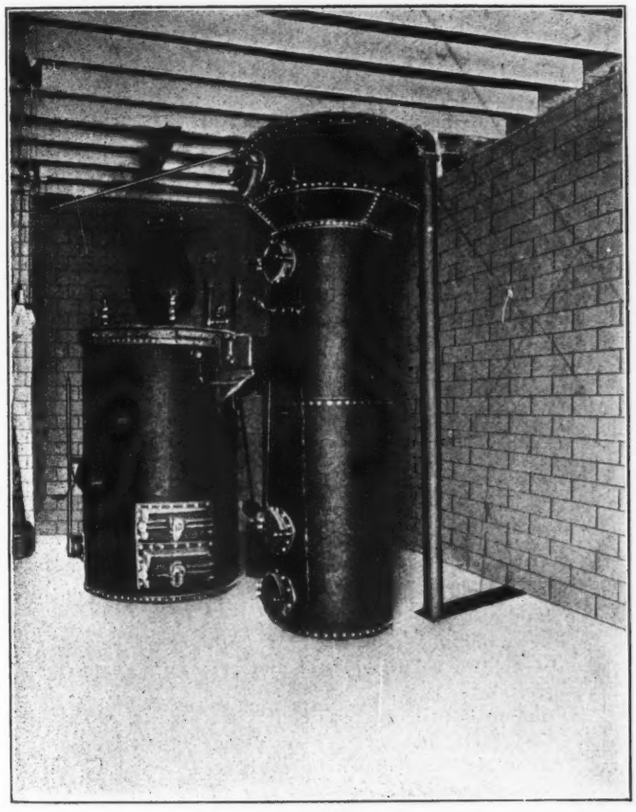
The United States Civil Service Commission announces an examination on December 5 and 6, 1906, for an architectual and structural steel draftsman at a salary of $125 per month.

PRODUCER GAS FOR POWER AND FUEL.

Julius I. Wile.

The application of Producer Gas for both power and fuel purposes in America, is gradually following the lead of European nations, where its use was first adopted some twenty-five years ago, and where developments and improvements have been rapidly made in recent years. Its use is daily finding greater favor with the layman as well as the engineer, as the most reliable means of obtaining the maximum energy from fuel.

Producer Gas can best be defined as the resultant gas producer by a mixture of steam and air passing through an incandescent fuel bed. For some uses, such as for gas engine service or for transmission through pipes to burners, the gas is cooled and cleansed in suitable apparatus, while for furnace use the gas is often taken hot, direct from the producer. Compared to steam boiler practice, where a complete combustion is desired so as to convert the carbon of the fuel into CO_2 and where a thin fuel bed is used for this purpose the manufacture of Producer Gas calls for an incomplete combustion, with the conversion of the carbon into CO through a deep fuel bed.



A SUCTION GAS PRODUCER

The absorbing interest now being taken in Producer Gas is largely accounted for by the great economies to be obtained by its use in an internal combustion engine, as compared with the use of coal under steam boilers, and used in steam engines. In the use of steam boilers and engines, it is well known that the economy depends upon the types and sizes of boilers and engines; also to a large extent on the auxiliary apparatus, such as condensers, superheaters, and economizers, which are employed. Even with these auxiliaries the best thermal efficiency ever obtained in steam practice is not much greater than 15 per cent. of the original value of the coal converted into work, while efficiencies of 3 to 6 per cent. are more common, especially in units of from 50 to 500 horse-power, where non-condensing engines are employed. With gas producers and producer gas engines, an efficiency of over 22 per cent. is now common and even in comparatively small units, while the tendency of this latest power is even toward higher efficiencies; as high as 24 per cent. having already been obtained. An average table of efficiencies of steam engines and boilers for the different types of engines are as follows; the coal used being assumed to have a heat value of 13,000 B.T.U. per pound:

Type	Pounds of Coal Per B. H. P.	Thermal Efficiency Per Cent
Simple non-condensing, Throttling	6	3.26
Simple non-condensing, Automatic	4½	4.35
Simple non-condensing, Corliss	3½	5.6
Compound non-condensing, Corliss	3	6.55
Compound condensing, Corliss	2¼	8.75
Steam Turbine condensing, Corliss	1¾	11.25
Triple condensing, Corliss	1⅓	14.75

The efficiency of gas engines and Suction Gas Producers from actual tests for different size engines are as follows:

B.H.P	Type	Fuel	B.T.U. per Pounds	Fuel in pounds per B.H.P.	Thermal Efficiency Per Cent
20	Single Cylinder	Anthracite	15.138	0.797	21.25
90	Single Cylinder	Coke	12.411	0.91	22.5
250	Double Acting	Anthracite	14.600	0.744	23 1-3
300	Two Cylinder	Anthracite	11.370	0.975	24

As fuel for large furnaces, Producer Gas is widely in use in steel and glass works for melting and other industrial purposes where the gas is taken from the generator hot into the furnaces. These applications of Producer Gas have found wide favor chiefly on account of the ability to transport the gas long distances, while centralizing the coal and ash supply, and also due to the fact of the economy to be obtained by burning gas with the correct ratio of air; while if coal were used (in order to effect complete combustion) an excess amount of air and consequently a waste of heat is required. Rapidity of output has also been obtained due to the control of the heat. In steel works, by the introduction of Producer Gas for fuel, the capacity has roughly increased 33 1-3 per cent. with an added economy of fuel, 25 per cent. The gas used in steel works is gas made from bituminous coal, which has not been cleansed, and therefore contains volatile matter and tar. This gas is transported through large brick flues, where the tar can be deposited. These flues are cleaned weekly.

Gas Producers for gas engine service and for transmission through pipes and burners always include cleaning apparatus; otherwise the tar and impurities would clog the valves, pipes or burners. From such producers we are thereby enabled to obtain a clean gas which is suitable for distribution over long distances. They furnish a cheap supply of artificial gas to take the place of illuminating gas, which is costly, or where natural gas has given out. The total fuel cost of Producer Gas, with coal at $3.00 per ton, is 2 cents per thousand cubic feet. Compared to illuminating gas of 575 B. T. U. per cubic foot, about five times the amount of Producer Gas is necessary to do the same work; while seven times the amount is necessary to do the same work as natural gas; therefore to be the equivalent of one thousand cubic feet of illuminating gas, the fuel cost of Producer Gas would be 10 cents; while for natural gas it would be 14 cents. Should the price of coal be higher or lower than $3.00, the fuel cost will be in the same proportion. For instance in Pittsburg, with coal at $1.50 per ton, the cost of Producer Gas to do the same amount of work as one thousand cubic feet of natural gas would be but 7 cents.

The application of Producer Gas for fuel calls for pipes at least twice the diameter of those used for illuminating gas. Burners are required with number and size of openings which will burn the gas at the best efficiency and obtain the heats required. In the use of Producer Gas, which burns with a

blue flame, the necessity of air blast commonly used with illuminating gas is eliminated. For temperatures as high as 2000 deg. F., provided proper burners are installed, it is not necessary to pre-heat the air, while if higher temperatures are wanted, it is necessary to install recuperative or regenerative furnaces as in glass or steel works. Experiments are now being made with a view to supplying Producer Gas furnaces for the higher temperatures where the recuperative or regenerative furnaces are done away with, and whre all parts of the furnaces are above the floor. Increased output over the older types is also expected.

The selection of a Producer Gas engine should be confined to those firms which have designed engines especially for Producer Gas. The differences between Producer Gas engines and illuminating or natural gas engines are largely in the size of valves, ports, increase of compression, method of mixing the air and gas, and special ignition. Compressions as high as 150 pounds compared to 90 pounds used on natural gas are employed. The air and gas do not mix until they reach the valve, and the valves should be so designed that a layer of air will come between the exhaust gases passing out and the incoming mixture.

Producer Gas is composed of carbon monoxide, hydrogen, carbonic acid, nitrogen and also a small amount of marsh gas. An analysis by volume of Producer Gas is as follows:

CO	25%
H	12%
CH_4	1%
CO_2	5%
N	57%

The heat value being 140 British Thermal Units per cubic foot of gas. The amount of combustible due to the amount of CO, H and CH in the above is 38%.

In the formation of Producer Gas, air is admitted in the bottom of the fuel generator, where it combines with the carbon of the fuel and burns to CO_2 which reaction in itself generates heat. The CO_2 gases pass through the incandescent carbon, where on account of there not being any oxygen present, they are converted into CO by taking up the carbon of the fuel, as follows: CO_2 plus C equals CO.

The manufacture of Producer Gas always carries with it the use of steam, which serves two purposes; one that it helps to keep the clinker from forming, due to the reduction of the temperature of the fuel bed, and further furnishes oxygen without the presence of nitrogen. Steam when decomposed by the incandescent fuel, separates into its component parts, thereby enriching the gas by the liberation of the hydrogen and furnishing oxygen for combustion without the presence of nitrogen. The reaction is as follows:

H_2O plus C equals CO plus H_2
and $2H_2O$ plus C equals CO_2 plus $2H_2$

Both of these reactions take place in the Producer; the first being effected by higher temperatures, while the second is effected by lower temperatures of the fuel bed.

Producer Gas is made in three types of Gas Producers: Suction Gas Producers, Pressure Gas Producers, and a combination of both Suction and Pressure Gas Producers.

In Suction Gas Producers the gas is made by the draught due to the suction of the piston of a gas engine and is always under atmospheric pressure. The extent of the draught and the amount of gas supplied is automatically controlled by the load on the gas engine and no storage reservoir is required, and no external means are necessary to make the gas. A Suction Gas Producer, as here shown, comprises the following main parts: Gas Generator, Steam Vaporizer, Wet Scrubber, Dry Purifier, together with all connecting pipe. Suction Gas Producers have many advantages, but are limited to power applications only because the gas is under suction caused by the engine and cannot be utilized for any other purpose. They have a high efficiency, as much as 85 per cent of the fuel being converted into cool and clean gas.

For the distribution of gas, or where several engines are located at considerable distance from the producer, or when gas is wanted for fuel purposes or for power and fuel purposes, it is necessary to put the gas under pressure.

In Pressure Gas Producers, the gas is under pressure above that of the atmospheric pressure. This pressure is caused by some external means such as a steam pressure or fan blower introduced before the producer, the gas being stored in a large gas holder.

Pressure Gas Producers, where the pressure is supplied before the Gas Generator, have now been in use for over 25 years. This type of Producer, however, is subject to many changes in the quality of the gas, and consequently calls for the use of large gas holders. In order to obtain a uniform quality of gas, and thereby enable a small gas holder to be used, the latter types of Pressure Gas Producers are of combination Suction and Pressure types; that is, a fan is attached to a producer of Suction type, while the gas is put under pressure; by means of controlling the draught the amount of gas made is controlled and a fixed proportion of air and steam is drawn through the gas generator independent of the resistance of the Producer, thereby overcoming the main objection to a straight Pressure Producer where the proportion of air and steam varies with the resistance of the Producer.

This combination Suction and Pressure Producers, which are called Pressure Producers as the gas is under pressure, make a uniform quality of gas, and enable a small gas holder or regulator to be used. These regulators can assume very small proportions provided the controlling of the gas is made automatic; otherwise the holder must naturally be larger so as to provide a larger storage capacity. In this type of Producer the draught is caused by external means and is always placed after the producer and before the holder. The steam necessary for the Producer, as in a Suction Producer, is raised by the gases on their way to the cooling apparatus, so that outside steam is not required. Efficiencies of over 80 per cent are obtained, compared to 50 to 65 per cent of older types.

A Pressure Producer of the combination type comprises the following main parts: Gas Generator, Steam Vaporizer, Wet Scrubber, Dry Purifier, Fan or Steam Exhauster, Gas Holder, Regulation of the draught and all connceting pipe.

Producer Gas is made from various kinds of fuel, such as anthracite, charcoal, coke and from bituminous coal, lignite, wood, peat and other fuels containing carbon. These fuels are classified as "non-bituminous" and "bituminous" and the class of fuel used determines the type of gas generator to be employed.

Non-bituminous fuel, such as anthracite, charcoal and coke, have little volatile matter and are easily adaptable for making producer gas.

Bituminous fuel, such as soft coal, lignite, wood, peat and other fuels, have larger quantities of volatile matter and contain tar, which must be eradicated.

There are two distinct methods of eradicating the tar from the Producer. The older method is to wash out the tar by means of adequate scrubbing and cleaning apparatus. The modern method is to convert this tar into permanent gas in the Producer generator and use only standard purifying apparatus such as would be used with non-bituminous fuel. The latter method is a distinct improvement over the former, as the tar in the fuel often comprises in ordinary soft coal, up to 10 per cent, while in lignite and other fuels even more than 25 per cent of the heating value of the coal.

In addition to the loss due to eradicating this tar, there is a further loss in the older method due to the large amount of water and power necessary to get successful results from the operation of the cleaning apparatus.

A producer of the former method has an efficiency of from 50 to 65 per cent of the heat of the fuel converted into cool and clean gas. This efficiency takes into account the amount of coal used to raise steam and the amount of power

required to drive the blower as well as the amount of power required to drive the scrubbing apparatus. In this latter type, or Combination Suction and Pressure Producers, in which the tar is eradicated in the Producer itself, an efficiency of over 80 per cent has been obtained, which takes into account the amount of power required to drive the fan exhauster.

In Europe the use of the Suction type of Producer, both for bituminous and non-bituminous fuels, especially lignite briquettes, has become very universal, while in this country the success of the Suction Producer has until recently been limited to the use of non-bituminous fuel, such as anthracite, coke or charcoal. In using bituminous coal the impression has been that it is necessary to use a Pressure Producer, while there is no more reason for using a Pressure Producer when using bituminous fuels than for non-bituminous fuels. Probably the prejudice in favor of Pressure Producers for bituminous coal is due to the fact that on account of the larger American gas engines having been built for natural gas, in order to get the large volume of Producer Gas necessary into such engines, it has been of advantage to put the gas under pressure. If the gas engine were designed especially for suction gas, it would not be necessary to have the gas under pressure. Bituminous fuel producers, however, are not practicable in units less than 100 H. P., as due to the tendency of the fuel to cake, it is necessary to have a suitable bed of fuel to deal with. As to the extent of the cleaning apparatus, if the proper Producer is employed it is not necessary to use any greater amount of water nor any larger dimensions than would be required with an anthracite plant.

Producer Gas Engines are now usually made in single cylinder up to 150 H.P. in both vertical and horizontal types. These types are no doubt the simplest and best for work where close regulation is not of the utmost importance, such as flour mills, pumping stations, etc. If close regulation is desired, such as for electric light work, cotton mills, etc., a two cylinder engine is to be preferred. Double acting units are used in sizes of 150 H. P. and upwards in both single and tandem engines, and for the larger units of 500 H. P. and upwards, the tandem double acting and twin double acting four cylinder type seem to be favored. The two cycle type of engine, as applied to producer gas, has not as yet been so extensively adopted.

In an installation at the works of the American Graphophone Company, Bridgeport, Conn., a battery of three producers is now used to supply gas for fuel purposes, taking the place of illuminating gas. The fuel cost of the gas replacing one thousand cubic feet of illuminating gas is 15 cents using coal as high as $4.00 per ton, while the interest, depreciation and attention add on another 15 cents making the total cost of gas 30 cents compared to $1.00 previously paid. The gas is used for heating wax kettles, japanning, soldering, boiling water and for open flame work. A notable feature in conjunction with the use of this gas is that no air blast is required which was previously used with illuminating gas to obtain the heat required. This installation is probably the first to replace illuminating gas for the purposes as above outlined.

The leading steam engine builders of the United States are now building gas engines especially designed for Producer or weak gases, and the most successful builders up to the present are those who have followed the European practice.

It is the writer's opinion, however, that American firms will overtake and distance European firms both in extent and improvements in gas producers, gas engines and producer gas applications.

AFTER-BURNING IN THE GAS ENGINE.

According to "The Engineering Times," Professor Hopkinson of Cambridge University, England, has used platinum resistance thermometers to investigate the explosions of homogeneous mixtures of coal gas and air at atmospheric pressure and temperature. The mixture was placed in a cylindrical vessel and fired by an electric spark at the center. The platinum wire used for the thermometer was exactly 1-1000 in. in diameter. When the flame approached the wire there was a sharp rise in its electrical resistance, and this could be easily measured, for the wire was placed in series with a battery of constant potential. When a thermometer was placed near the spark it was found that on ignition of the mixture there was a sudden rise of temperature to 1,200 degrees C. It was found that if the gas was fired in a closed vessel, whose volume did not alter, the differences of temperature in various parts of the vessel at maximum pressure after an explosion of this kind varied as much as 500 degrees C. With weak mixtures of gas and air it was found that the spread of the flame was much slower. With one volume of gas mixed with twelve volumes of air it was found that 2½ seconds elapsed before all the gas was burnt. With a mixture of one volume of gas and nine volumes of air the flame spread rapidly from the spark, and all of the gas was completely burnt within 1-40 second. The results are used to explain the phenomena of "after-burning" in the gas engine; and it is argued that the observed specific heat of the products of combustion, together with the loss of heat during the passage of the flame through the compression space, accounts for all of the peculiarities of the gas engine diagram.

SUPERHEATER TRIALS ON A BATTLESHIP

The battleship Britannia is the first warship to be fitted with steam superheaters, and the analysis of the results of her trials is interesting, as it reflects light on the economy of the system. Six of the boilers in the Britannia had superheaters in the uptake, and as this number was equal to drive the engines at one-fifth of their power, it was decided to run two trials, each of thirty hours duration, the one with ordinary steam and the other with the steam superheated to the extent of 90 deg. Fah. The result was to reduce the coal consumption by about 15 per cent., and to reduce also the temperature of the gases escaping from the funnel by 50 deg. In other words, with ordinary steam the coal consumption was 2.07 lb. per I horsepower per hour, as compared with 1.77 lb. while using superheated steam. Again, on the higher power trials the influence of the superheating of part of the steam had its effect as on the trial at 70 per cent of the power the coal consumption was 1.5 lb. per I H. P. per hour and at full power 1.83 lb. It is, however, at low powers that the gain is most wanted, as then the consumption is high owing to the auxiliary machinery taking such a large portion of the steam. Moreover, warships run for the greater part of their time at low power, so that if the gain of 15 per cent shown on trial can be maintained in service, the coal bill for the year will be appreciably lessened.

E. A. Klippel, Superintendent of Telegraphs on the Harriman system in Oregon and Washington, is making a series of experiments with train telephones, the purpose being to devise a plan whereby the conductor will be able to converse with any one in any part of the train from the engine cab to the sleeper. It is also proposed to install the service on freight trains. The telegraphone was worked successfully a few days ago on a distance of 200 miles, and gave satisfaction. The test was made from a freight caboose during the early morning hours, when no train orders were being sent over the wires in the regular way.

UNDERGROUND CABLES.

The use of underground cables for the transmission of power by electricity has become so universal that no apology is necessary for bringing before the members of this association a few points which seem to the author to have failed to receive the attention they deserve.

Underground cables, as used by the members of this association, may be grouped into three classes, viz.:

(1) High-tension multiple or single conductor cables of relatively small current carrying capacity, but capable of operating under working pressures from 2500 to 25,000 volts mean effective pressure.

(2) Low-tension single conductor cables of large current-carrying capacity, but only operating under pressures of 650 volts or less.

(3) Negative return cables of large current-carrying capacity, but only operating under a pressure corresponding to the drop in the return feeders.

The first class, comprising what is popularly known as high-tension cables, has developed by a process of evolution from the time when nothing but rubber was used for insulation, to the present time where rubber, varnished cambric, saturated tapes and paper insulation have been brought to such a state of perfection as to leave little to be desired.

Higher voltages than 25,000 have not been attempted as yet in underground cables, but there seems to be no reason why a voltage of 44,000 should not be used with exactly the same degree of safety as 25,000, provided a star connection is used in the transformers and the neutral point is grounded, for then the maximum strain is limited to 25,000 volts to ground. It would thus seem that our cable manufacturers have almost kept up with the development in overhead construction, as at this time 60,000 volts is the maximum pressure in use in a few cases only, and the great majority of important transmission schemes are under 50,000 volts.

For economic reasons, principally, rubber insulation is only used where local conditions seem to demand an insulation which is impervious to moisture, so that in case the lead sheath should be punctured, the cable will not necessarily fail.

As an instance, where cables have to be installed in ducts, which are under water part of the time, or for submarine cables, the extra investment for rubber insulation would seem to be justified, as in the event of a leak in a submarine cable lead sheath it usually becomes a total loss if insulated with paper or other non-moisture proof material, whereas good rubber will last indefinitely under water.

For potentials aboue 22,000 volts it seems likely that some form of varnished cambric or impregnated cloth will take the place of paper, owing to its higher puncture resistance for a given thickness, but experience with working pressures above 22,000 is so limited that we must wait some time before any definite conclusions can be reached.

As the result of some fifteen years of experience with underground cables, the following table, giving thickness of insulation and lead sheath for various sizes of conductors and working pressures, is submitted as representing conservative practice:

TABLE NO. 1.—PAPER INSULATION. STANDARD WORKING PRESSURE OF 3000 VOLTS.

Sizs of Conductors	Thickness of Single Cond.	Thickness of Lead Single Condl	Three Cond
No. 6 to No. 2 B. & S.....	5-32 in.	5-64 in.	3-32 in.
No. 1 to No. 00.....	5-32 in.	3-32 in.	7-64 in.
No. 000 to 300,000 cm	6-32 in.	7-64 in.	9-64 in.
400,000 to 750,000 cm.....	6-32 in.	7-64 in.	.....
800,000 to 1,000,000 cm	7-32 in.	4-32 in.	.....
1,250,000 to 2,000,000 cm ..	8-32 in.	9-64 in.	.....

*An address by H G. Stott, Superintendent Motive Power Interborough Rapid Transit Co., New York City, before the Convention of the American Street and Interurban Railway Engineers' Association.

For each 1000 volts increase of pressure above 3000 add 1-32 in. insulation to the wall until 11,000 volts is reached, and after that add 1-64 in. for each 1000 volts. For example, the insulation required on a No. O. B. & S. 25,000-volt cable would be 20-32 in. or 5/8 in. If 35 per cent para rubber compound or varnished cambric is used for insulation, the above empirical rule may be changed to read: for each 1000 volts increase above 3000, add 1-64 in. insulation to the thickness of wall until 25,000 volts is reached. For the insulation of low potential cables in class II, 4-32 in. paper should be used on all sizes up to 1,000,000 c. m., and from 1,250,000 to 2,000,000 c. m., 5-32 in. should be used.

From a purely electrical point of view one-half of this insulation would be ample to withstand 650 volts working pressure, but the mechanical effects of reeling and unreeling the cable and pulling it into ducts and bending around the manholes, are to practically destroy the insulating qualities of the layer of paper next the lead, so that we really start in with a cable having approximately 1-32 in. of its insulation destroyed before it is put into commission; this mechanical destruction of insulation is especially marked in cold weather, as the oils used with the paper tend to congeal when subjected to a temperature below 32 degs. F. The cable manufacturers have met this difficulty by using more fluid oil with the result that the insulation resistance of the cable may not be more than fifty megohms at 60 degs. F., but by the use of this very soft insulation they have produced a cable giving a very low insulation, but a high puncture test, and at the same time have met, to a great extent, the difficulty of handling paper cable in cold weather. It is always advisable, however, if a cable is to be used in a temperature below 32 deg. F. to keep it in a warm place, such as a boiler room, for at least twelve hours before drawing it in. The cable may then be used in the coldest weather, as it gives up its heat very slowly.

Class III cables have up to within the last three years received very little attention, as, in almost every case, bare copper cables were installed. But a closer study of the electrolysis problem indicates that in many instances the use of insulated, negative cables would eliminate a great deal of the trouble and damage to cable sheaths, etc.

When electricity leaves a conductor in wet or moist ground the water in its path is decomposed into its constituent gases, having the chemical symbols H_2O, and oxygen attracts almost all metals, forming an oxide of iron or oxide of lead or copper, as the case may be, slowly but surely destroying the metal. A pressure of two volts is sufficient to decompose the water, so that the ordinary negative drop of from five to twenty-five volts possesses ample possibilities in the way of electrolysis, if not properly taken care of.

In the ordinary location of direct current power plants in our smaller cities, only one generating station is used, and sufficient positive copper is installed to give the necessary potential on the trolley, the negative or return circuits being taken care of by the track rails up to the nearest point to the power plant or sub-station, and from this point bare negative feeders are used to conduct the current back to the grounded negative bus in the station. The maximum amount of copper installed in this negative rarely equals that used for the positive, so that in all probability there will be at least five volts drop from the nearest track rail to the negative bus. and if longer bare negative feeders were used running to the various points of heavy traffic, the drop on them will be at least 4 per cent, as the financial burden caused by interest on capital invested becomes too great if a smaller drop than this is used. We thus have bare negative feeders with a potential of from 5 to 25 volts on them, running parallel to our positive and high tension feeders, as well as our neighbors' cables, gas mains, water mains, etc., and a few bar rail-bonds may increase this drop several per cent.

The negative feeder may, therefore, be looked upon as an infinite number of small battery cells coupled in series with

their negative pole, coupled to the negative bus in the power house or sub-station, and their positive coupled to the track rail, with some good and some bad connections, all along the line to the various lead sheaths of the cables running near them, as well as to gas mains, etc. If the connections between one of these imaginary cells and a lead sheath be sufficiently good, then this battery's potential of perhaps 10 volts will be on the cable sheath and will cause a current to flow from it at some other point along the line where the negative return is at a lower potential. At the point where the current leaves the lead sheath, electrolysis will occur, and in time the feeder will break down from the moisture admitted through the perforated lead sheath.

The above conditions obtain to a greater or less extent in all systems having bare negative returns and grounded negative bus bars, no matter how many sub-stations may be in use.

An obvious remedy would seem at first sight to be the bonding of the lead sheaths of all feeders to the bare negative cables at frequent intervals, but this introduces another trouble which may be as serious as electrolysis. A short-circuit in a positive feeder to ground, will cause an enormous current to flow through the lead sheaths, and in all probability burn off the bonds and destroy the lead sheaths in a number of cables. Instances of this have occurred to the author's knowledge, in which the lead sheaths have been completely burned off for 400 feet on cables that were entirely innocent of the origin of the trouble.

Another source of trouble, due to the use of the grounded negative bus and bare feeders, is in the other feeder's lead sheaths carrying the negative current back to the power house or sub-station by an entirely different route from that taken by the bare negative feeders, with the result that this return current leaves these lead sheaths, either in the power house throuhh a ground put on them or through some accidental ground, such as a cable hanger in a manhole. Every time a short-circuit comes on the system a rush of current will flow through these lead sheaths, and, perhaps, puncture small holes in the lead.

The most satisfactory solution of these problems of avoiding electrolysis and saving the lead sheaths from destruction seems to be in the use of an insulated negative bus in the power house and sub-station, and insulated negative feeders right up to the track rails. For this purpose, the negative feeders should preferably be insulated with some material which does not require the use of a lead sheath. Several types of insulation are now on the market, which promise to be very satisfactory for this purpose, as the potential carried by the negative feeders is quite low.

The ideal solution of the problem would be found in the use of the feeders without lead sheaths, and some very satisfactory tests are now being made on experimental lengths of 650-volt cable of this type, but it does not seem probable that any cable can be constructed at present which will safely stand being drawn into wet ducts and manholes and used continuously on pressures above 2000 volts without the protection of a lead sheath to keep out the moisture.

By using insulative negative feeders and avoiding all grounds in the power house, or sub-station, it is evident that there will be little or no tendency for the return current to leave the track rails, if properly bonded, and absolutely no tendency for stray currents to come back to the power house or sub-station by way of lead sheaths, gas mains, etc., thereby relieving us of probably 75 per cent of our present electrolysis troubles.

Coming back to Class II cables, the safest plan seems to be to insulate the lead sheaths of all feeders by supporting them on racks having some form of insulation between the lead sheath and the hanger.

All cables should also be wrapped with two layers of ⅛-in. asbestos in every manhole where more than one cable is on each side, in order to afford protection from an arc caused by any one of them burning out. In perfectly dry places this asbestos wrapping can be secured very neatly by applying silicate of soda to it, the soda in itself being a good protection against fire; in the average damp manhole this soda will soon loosen and the asbestos wrapping will fall off, so that, in this case, a galvanized steel tape about ⅝ in.x1-32 in. should be used to hold the asbestos in place.

In order to get early warning of the breaking down of any positive feeder, and so give time to have it cut out before doing any further damage to itself or neighbors, a small insulated wire (say No. 14, B. & S.) should be connected to the lead sheath and brought up to a panel where the switchboard operator can see it. On this panel may be mounted one or two lamps for each positive feeder, and these lamps connected to ground through a resistance large enough to limit the current to the amount necessary to light the lamps when the pilot wire attached to the lead sheath to any feeder becomes alive through the grounding of that feeder on its insulated lead sheath. Ammeters or relays operating a gong may also be used with advantage for this purpose at a very small cost per feeder.

In reference to Class I, or high-tension three-phase cables, their lead sheath should be insulated and wrapped with asbestos in the same manner as described for Class II, with the additional precaution that their lead sheaths should all be bonded together and grounded in the generating plant. The neutral, or star point, of the generators or transformers should be grounded through a resistance of such dimensions as to limit the current, flowing through it when a ground occurs on a high-tension feeder, to the amount necessary to trip the overload relay. For example, on a large installation using 11,000 volts for distribution to its sub-stations, the neutral connection is one having resistance of six ohms, and a carrying capacity of 1000 amps. for 1 minute. As the Y potential to ground is 6300 volts, this limits the current to a maximum of 1000 amps., when the feeder grounds.

This system was adopted after some rather disastrous experiences with short-circuits on high-tension feeders, and has been in successful operation for over a year.

When a high-tension cable breaks down, it almost invariably goes to ground from one phase only, and then after the charging current of the whole system has been flowing to ground through this fault for perhaps 10 to 20 minutes, the insulation of the other phases is burned off, so that a short-circuit on two or three phases occurs, with the result that either the whole system is shut down, due to the sudden fall of potential, to perhaps one-fourth of its normal value, or at least one or two sub-stations are shut down from the same cause. With the neutral grounded through a suitable resistance, the oil switches, on the grounded feeder only, trip out quietly without any disturbance whatever to the rest of the system.

If the three-phase high-tension cables are not grounded in the generating plant, the burning out of a cable will puncture the lead sheath at a number of points, possibly a thousand feet away, as it is obvious that the current must leave the lead sheath somewhere, and the easiest path is usually found at the cable hangers in the manholes. This will be true no matter whether the neutral is grounded or not.

As a further precaution, it is advisable to bond the lead sheaths of the a. c. feeders quite frequently in the manholes by wrapping on a lead strap, say ⅛ in. x 2 ins. to the lead sheaths. Bonding by wrapping the lead sheaths with a few turns of copper wire is worse than useless, as the copper wire, if put on tight enough to make a good connection, may cut through the lead, and if not tight enough to do this it will probably make such a poor contact as to arc when current passes.

In conclusion, the author wishes to state that, in his opinion, at least 75 per cent of cable trouble is caused by defects in the lead sheath and not by defects in the insulation.

Examine the ordinary vitrified duct and you will find that the inside, in all probability, contains several small hard sharp points projecting from 1-16 to ⅛ in. What happens to the lead sheath of a cable when it passes over these projections? A groove is cut in it in exactly the same way as by a tool in a planer. The result is that a little extra pressure, caused by a kink in the cable, will cut through the lead and admit the moisture, which, sooner or later, will destroy the insulation.

Outside of trouble in joints caused by carelessness on the part of the jointer, practically all cable trouble can be eliminated by the more careful choice and installation of conduits, by a very careful inspection at the time they are laid, and by the use of cutters and cleaners after they are laid.

Lastly, do not try to get a low price on a cable by reducing the thickness of the lead sheath, as the integrity of the lead sheath is fully as important as the quality of the insulation, and the life of the latter is wholly determined by the degree of perfection obtained in excluding moisture from it.

AN AMUSING COMMENT.

An English journal made the following comment on an article which appeared in a recent number of the "Street Railway Journal," in which the writer apparently recommends that when the cross arms of a single pole are to carry circuits of various potentials, the high voltage wires, which ought to be the strongest, should go on the top, and so on down to the telephone and signal wires on the lowest arm, unless it is more convenient to put these just above the local lighting circuits:

"The calm way in which are carried on one pole circuits varying from 30,000 volts three-phase a. c. to 600 volts d. c., and telephone wires, is likely to amaze the unsophisticated Briton, who is accustomed to bury each circuit decorously in separate conduits underground, and we do not think for a moment that the authorities ever will permit such a mixture here, nor should we think it fit for them to do so, doubtless on account of our narrow insular minds.

"No one has insisted more strongly than ourselves that aerial transmission and distribution lines are essential to the prosperity of the mines and factories of this country, as without them no power scheme of large extent can flourish, but we never carried our suggestion to the length which is accepted as common practice in America.

"If many serious accidents had been caused by these methods, we cannot believe that the tone of the article under consideration could have been so matter-of-fact and placid, so we are bound to think that they have been successful; in which case we have another object lesson to demonstrate the fact that high-tension overhead transmission can be carried out without the elaborate precautions deemed necessary in this country."

The United States Civil Service Commission announces an examination on December 5 and 6, 1906, to secure eligibles from which to make certification to fill at least four existing vacancies as they may occur in the position of aid in the Coast and Geodetic Survey, at $720 per annum.

As the Commission has experienced considerable difficulty in securing a sufficient number of eligibles for this position to meet the needs of the service, qualified persons are urged to enter this examination.

The examination will consist of the subjects mentioned below, weighted as indicated:

Subjects.	Weights.
1. Mathematics (including geometry, plane and solid, algebra, trigonometry, and the elements of calculus)	15
2. Practical computations (involving the use of logarithmic tables)	15
3. Astronomy (elementary questions in spherical and general astronomy, with special reference to determination of latitude, longitude, and azimuth, and use of field instruments)	10
4. Physics (elementary questions in optics, magnetism, etc.)	10
5. Surveying (elementary questions in plane and geodetic surveying, and use of field instruments)	10
6. Modern languages (competitors may select one of the following: French, German, Spanish, Italian. Extracts of about 100 words are given for translation into English)	10
7. Drawing and descriptive geometry (a short test in topographic drawing and lettering is given with elementary questions on the principles of projection)	10
8. Training and experience (rated on application form)	20
Total	100

THE INTERNAL CLEANING OF ELECTRICAL MACHINERY.

The attention required by electrical machines, whether stationary or with moving parts, is little, but that little needs to be carefully bestowed to be effective. Next to the lubrication of rubbing surfaces, which is generally of the simplest nature possible, cleaning is the most important consideration, particularly with regard to internal regions, where heat is most likely to affect any matter present.

A large proportion of electrical machinery, generators, motors, rheostats, etc., is of such construction that the interior is not accessible for the removal of the ubiquitous-matter-out-of-place by the direct application of the usual agents, namely, rags and waste, which suit the purpose so far as the exterior is concerned. In order to meet the necessities of the case air is pressed, or rather compressed, into service, with the result that cleaning can be thoroughly accomplished by a jet of air under a pressure of some twenty or more pounds per square inch above the atmospheric pressure.

When the amount of cleaning to be done is small, as in the case of an installation of one or two motors of some ten or twenty horse power, a pair of hand bellows energetically applied once or twice a week will prove amply sufficient for the purpose; but where the machines are many or of larger size a more powerful and sustained source of air-blast must be utilised to obtain the utmost expedition. As an example of the latter case may be taken any electric generating station with more than four or five generators, where it is desired so to arrange the duties of a limited staff that they can do multifarious tasks as readily as possible.

It is found that if an air compressor is installed with a suitable system of piping the machinery can be kept in a more satisfactory state with one quarter the time, and less than that proportion of human energy that will be required if a pair of bellows is applied to each machine with the necessary intervals of rest between.

A suitable equipment of the kind for a central station consists of an air compressor driven by a motor or engine, of about ½ horse power, fixed in the machinery room with a 1-inch main air pipe under the floor in connection with a cylindrical reservoir of about 3 cubic feet capacity. From the main pipe a ¾ inch branch with a valve, just above floor level, is taken up to each generator with a pipe terminal to which may be attached a flexible hose of the length necessary to reach all parts of the machine. The hose should be of the kind protected by wire, and may suitably terminate at the "business" end in 6 inches of ¾ inch brass tube hammered flat at the point to make a slit-like oirfice 1 inch x 1-16 inch, this shape enabling it to be presented more effectually than a circular nozzle between armature windings.

To take a different case, where the machinery is to be operated on consists of many motors in different parts of a building, as in a tramway car shed, a portable electrically driven air compressor, with flexible leads and pipe, is a more useful apparatus.

AN ADDRESS TO ENGINEERS

The October number of "Sibley Journal of Engineering," a monthly magazine published by the students of Sibley College of Cornell University, treats in an editorial as follows regarding the outline of an address delivered before the engineering apprentices of the Allis-Chalmers Co., by Professor Karapetoff of the Department of Electrical Engineering.

The outline, with the comments as noted above are:

Introduction—Three essential conditions for a successful engineer:

a. Professional knowledge.
b. Knowledge of business forms and of human relations
c. Strong character.

I. Professional Knowledge.

1. While in the works you learn the construction of machinery, the manufacturing operations and testing without a particular effort. However, the question "why" is of decided importance; do not be satisfied with "how." Get into the habit of analyzing. To get full benefit from the factory work:—

a. Keep regular notes on your work.
b. Make sketches.
c. Keep on a separate sheet your doubts, to be straightened out at a future opportunity.
d. Make rough check calculations on machines you are working with.

The above is not sufficient by any means; you must devote part of your evenings to systematic study, namely:—

2. Read at least one electrical magazine regularly and keep some kind of an index of information on at least one subject in which you are particularly interested.

3. Go over your college books and notes and see that you are sure in fundamentals. A few things that you must be absolutely sure of are:—

Ohm's law, general law of induction and its application to machinery, the law of electrical energy. Besides, you ought to know the general theory of D. C. and A. C. machinery and transformers.

4. Gradually get familiar with the standard electrical books; go from time to time to the Public Library and see if there is anything new in your specialty.

5. Select some one branch of electrical engineering and devote all your extra time to it.

6. Do not miss a chance to make an original investigation whenever you have an opportunity.

II. Study of Human Relations and Business Forms.

You naturally expect to some day occupy responsible positions with this company or some other. This is impossible without a knowledge of human relations and business forms.

1. Observe the characters of men you are working with, in particular:—

a. Influence of age.
b. Education.
c. Nationality, etc.

2. Things that make them successful:—
Things that are an impediment in their work.
Things that they would like to have.
Things that make them happy and unhappy.
Betterment work that they would appreciate.

3. Observe the foremen, and their ways of conducting their departments.
Make clear to yourself what you would consider an ideal foreman.
Do not judge the foremen by the way they treat you.

4. Observe the general factory system as far as you can. In particular, gradually find out:

a. General subdivision of duties of the executive officers; the management, commercial, engineering, manufacturing, erecting, selling department, etc.
b. Arrangement of factory buildings, and the general idea of this arrangement.
c. Orders, cost, accounting, etc.
d. Causes of waste of time and materials, and possible remedies.

5. Get a thorough understanding of the significance of co-operation in modern industry.

6. Do not get rusty in regard to general life questions; continue reading books on philosophy, economics, history, etc. This will make human relations clearer to you. Besides, a man in a responsible position must be a well educated man; he should be posted on many general things and ought to be able to speak about them.

III. Training of the Character.

Engineering and business knowledge are the necessary conditions for usefulness ("success," and usefulness are not always the same), but the proper development of the character is the third necessary condition.

What is the use of having a profound engineering knowledge if you have not the necessary preseverance to achieve results; or to have a knowledge of business forms and relations, if your temper is such that nobody cares to be associated with you in business?

Practice daily the qualities of the character that you find essential for a good citizen and good business man.

1. Work patiently on any problem until a result is achieved. If it should be impossible to get satisfactory results, at least make clear to yourself the causes and limitations.

2. Be honest in all things; do not be afraid to confess your mistake or ignorance. Train your character by doing over your work cheerfully.

3. Keep down your selfish personality and ambition. Do not let them interfere with your business. The highest form of personality and ambition is to have your part of the work done in the most ideal way.

4. Be generous, polite and considerate to others; there are no circumstances where you would be justified in breaking this rule. Remain dignified even under unjust reproof.

5. Remember that you work for the future; shape it aright now, and it will come as you expect it to be.

Conclusion—Your opportunity will be no chance if you are ready for it.

Comments.

The substance of the address, although intended for men out of college, can nevertheless be applied profitably by the undergraduates, especially the first year men who are now in the process of developing their minds and lives. As has been so often said, "College makes or mars a man." We believe that a man should seriously examine himself at intervals to see how the trend of university affairs is effecting his life, and Professor Karapetoff's outline should be particularly useful for this purpose.

With reference to the first essential for a successful engineer,—that of professional knowledge, the suggestions given are thoroughly impressed in the Sibley student by the time he is ready to graduate; he realizes that he is "up against it," so to speak, and having selected a specialty he is well prepared, and we believe does follow along the lines indicated—assuming of course that his specialty appeals to him. If it does not, then he must expect only as much success as he has love for his profession.

Another point emphasized by Professor Karapetoff, namely, going over the text-books and seeing that one is sure in fundamentals, is one that we cannot urge too strongly. There is an inherent desire, all too prevalent among the students, to close their books when through with a subject and keep them closed. The sooner the students recognize the

importance of keeping fundamentals fresh in their minds, the easier will be their work.

The study of human relations is the second requisite mentioned. This can be begun right here in college; study your classmates; avoid the habits and manners that you find distasteful to you; cultivate the qualities which are helpful and pleasing; ask yourself, "What makes some men popular;" observe their manner toward you individually. The college man certainly has the right to expect to control affairs in the future, and by following these pointers he should be much better prepared to grasp opportunities.

In connection with the second requisite is placed a knowledge of business forms. This is not part of a college training and must necessarily be relegated to the time when the college man commences his life's work. But the sooner this study is undertaken and its details mastered the better will be one's chances in acquiring those additional characteristics that tend toward the making of a man of affairs.

The third requisite is character. This is in most cases formed while a man is at college, mainly through association and environment. Here is where his future life is determined. Tersely, a man of character is one who is honest with himself first, and honesty with others is bound to follow.

A MAGNETIC INDICATOR OF TEMPERATURE FOR HARDENING STEEL.*

The well-known troubles of warping and change of size when hardening tool steel experienced in the case of some specially exacting work, led me to seek some more reliable and convenient indicator of hardening temperature than those in common use. Dissatisfied with the results obtained by the use in an ordinary workshop of an electrical pyrometer employing a thermo junction, with the inconvenience of having to obtain a cooling curve with each sample of steel, and the uncertainty arising from the need of heating the object above the critical point so obtained, to meet the fact that the critical point for heating is higher than that for cooling, I sought to make use of the known fact that at this critical point the magnetic permeability of the steel is changed. With the co-operation of Mr. F. J. Mudford, I experimented with a magnetic induction balance consisting of three similar flat coils of wire placed parallel on a common axis and equally spaced, the inner coil in circuit with a telephone receiver and the outer coil supplied in series with an alternating current, and so connected that at ordinary times no sound was produced in the telephone. When, however, steel was placed between the center coil and either of the outer ones, the magnetic balance was disturbed and a sound produced in the telephone. The steel was then heated, and when it reached the critical temperature and became non-magnetic, the sound in the telephone abruptly ceased, whereupon the steel was quenched and hardened. Steels with carbon contents ranging from .7 to 1.35 per cent were hardened in this way at temperatures which, judged by the eye alone, no skilled mechanic would feel safe in using, while the fine grain shown on fracture, together with the invariable hardness, showed how closely the critical temperature had been obtained. In each case on letting the steel cool so that sound was resumed in the telephone the steel failed to harden, although the fall of temperature was imperceptible to the eye. Following this experiment, the magnetic indicator attached to a small muffle furnace was constructed, and has been in daily use in a tool-room for several months, where it has served to indicate temperatures for hardening press tools, milling cutters, taps, reamers, etc., and has established a record during that time in that not a single piece has been lost through warping or cracking in hardening, while the quality of the hardening has been excellent.

*Abstract of paper read before Section G of the British Association, by William Taylor

The attachment consists of a hardened steel permanent magnet, extended by soft iron pole-pieces into the general form of a horseshoe magnet, the gap of which is in the muffle of the furnace, and is so adjustable that the piece of steel to be hardened may be arranged to fill the magnetic gap. The pole-piece at one side of the furnace is hinged by rocking on the magnet, and is prolonged in such a way as to form a second and alternative magnetic circuit tending to displace the rocking pole-piece and withdraw it from the object being heated. This, however, so long as the object is magnetic, is prevented; but when its temperature rises to the critical point, and the steel object becoming non-magnetic releases the pole-piece, the latter rocks, and in so doing establishes an electrical circuit by which a bell is rung, giving audible warning to the attendant. This device has proved of great practical service by making the work of miscellaneous hardening safe and certain in its results. It is noticeable in every case that the temperature at which hardening is thus safely accomplished is visibly lower than that at which a skilled workman would ordinarily harden steel when endeavoring, on the one hand, to avoid overheating, with its resulting brittleness, cracking, and warping, and on the other hand, the failure to harden, and the certainty that in re-hardening these risks of cracking and warping would be multiplied

The apparatus was shown at the meeting and much appreciated by the engineers present. Samples of steel hardened in the way described were also on view. It was stated by the author that the heating of tools of considerable section needed to be done slowly; otherwise the signal was given too soon, when only the outside layers of steel were at the proper temperature. The president remarked on the useful application of a well-known physical fact for commercial purposes, and thanked the author on behalf of the section.

GASOLINE-DRIVEN CARS.

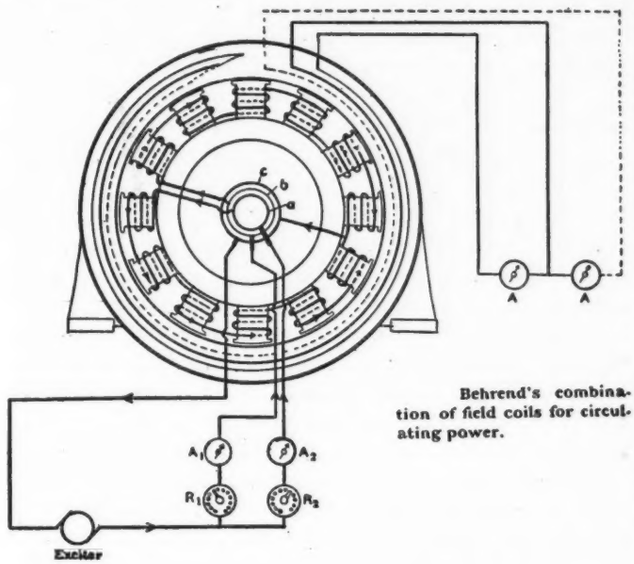
Some time prior to the development of electric interurban railways the steam motor car or dummy, in many cases hauling a trailer, was used to a moderate extent, but at the present time few of these remain. In response to a demand from railroad managers for a motor car to operate on branch lines and special situations there has been recently a development of motor cars employing gasolene in an internal combustion engine, this engine either directly driving the care or driving a dynamo to generate current to be used for driving motors on the trucks. Some builders interpose batteries between generator and motors to store the current when it is not all needed for propulsion, and to assist in starting on grades when the generator capacity may be insufficient. There is very great flexibility and convenience in this combination, but it is attained at very considerable expense and complication, and requires unusually skilled attendance not commonly available in railroad service.

WIRELESS TELEPHONE APPARATUS.

A novel wireless telephone apparatus has been patented by M. Blondlot of Paris. The transmitting antenna is excited by the effect of a closed circuit where continuous vibrations of very high frequency are produced by the stepwise discharge of a direct current or alternate current generator connected in parallel to a condenser battery, while the receiving antenna acts on a telephone with or without the use of syntonically vibrating local currents and wave detectors. The sounds to be transmitted act on the closed vibratory circuit by means of a manometric flame or a transformer, the primary coil of which is fed by a strong microphone, a singing arc, or any similar device.

THE BEHREND METHOD FOR TESTING LARGE ALTERNATING CURRENT MACHINES.

It is seldom that a shop is able to furnish current at a sufficiently high potential and load of sufficient capacity to conduct full load and overload tests on the large units being built at the present time. The desirability of testing electrical machinery in the shop has led to the development of methods of testing which make it possible to subject the machines to full losses in core and coils with the facilities ordinarily available. Moreover, such methods are generally much more economical.



Behrend's combination of field coils for circulating power.

Mr. B. A. Behrend, chief electrical engineer for the Allis-Chalmers Co., has devised an interesting method for testing alternating current generators and synchronous motors under conditions approximating full load. It is well known that the alternating current, by means of its property of being able to store energy during one-quarter of a period, and return it during the next quarter, allows the flow of large amounts of apparent energy in the form of so-called wattless currents. By properly exciting two alternating current machines operating in parallel it is possible to circulate a large quantity of apparent energy without having to supply more true energy than corresponds to the losses which take place in the machines. Such motor-generator tests as consist in operating one of the machines as a motor, running idle, have been made by Mr. Behrend for many years, and have been used for determining the regulation of alternators on low power factors, as well as of the heating under the same conditions.

This method has the disadvantage of requiring two machines of the same capacity, and involves the expenditure of power corresponding to the losses in two machines. The first to suggest the circulation of power within a single machine was Mr. William M. Mordey, whose method is described in Vol. II (1893) of the Journal of the British Institution of Electrical Engineers. To apply Mr. Mordey's method, for instance, to one of his single-phase generators having 20 poles on each side of a single exciting coil, the armature would be split into two sections of 8 and 12 coils each, and by connecting these sections in opposition only four coils would be effective in driving current through the armature.

The section of the armature which contains eight coils acts as motor, while the section containing twelve coils acts as generator. The current which circulates through the armature coils is almost in quadrature with the resultant e. m. f., and is, therefore, a wattless current. Hence, the eight poles of the motor section of the machine will be strengthened by the armature current, whereas the twelve poles of the generator section of the machine will be weakened by the same current. This leads to a magnetic unbalancing, since the motor fields carry more resultant flux than the generator fields. In Mordey's machine, this condition may not have caused trouble, as his machine does not contain iron in the armature; but in modern generators his method cannot be used. The magnetic attraction between the revolving and stationary parts is proportional to the square of the induction in the air-gap; hence if the magnetic forces are unbalanced, the successful operation of the machine is impracticable.

Instead of dividing the armature into two sections and connecting these sections in opposition, one may, especially in polyphase machines of the revolving field type, split the field into two sections and connect these in such a way that the e. m. fs. induced in the armature are in opposition. Such a method cannot be carried out in practice, as the machine vibrates and jurs in a manner which makes its operation under such conditions out of the question.

In order to circulate power successfully within a single machine it is essential to obtain uniform induction in the air-gap of both the motor and the generator poles. As the armature reaction strengthens the motor poles and weakens the generator poles, the impressed excitation of the motor poles must be smaller than the impressed excitation of the generator poles. This can be effected, as shown in the accompanying diagram, by splitting the field coils into two equal sets and exciting each of these with a different field current. This is the basis of Mr. Behrend's method.

The results obtained so far have been very satisfactory. Numerous tests have been made to check the new method against the results of synchronous motor-generator tests. The agreement was close. The terminal voltage corresponding to the conditions under which the machine is operating in the test can be determined by measuring the volts on a set of coils per pole and multiplying by the total number of coils; or by adding to the excitation on the motor fields, the excitation required to drive the armature current through the armature winding. Both methods have invariably given the same results.

Heat runs by the Behrend method on two generators of large capacity at full normal load and zero power factor yielded the following results:

		Deg.	Deg.
	Armature Surface	30	27.5
	Armature Coils	34	31.5
	Field Coils	34	31.5
Capacity, kilowatts		3,500	3,200
Volts		6,600	4,500
Revolutions per minute		75	75
Frequency		25	60
Hours		18	23
Loads K. V. A		3,500	3,870

The one drawback of the method consists in the fact that it is applicable only to machines having a comparatively large number of poles. It has not been successfully applied to machines having fewer than eight poles. The application of this method is confined to machines of the slow speed type, and with the advent of the steam turbine generator new methods will have to be devised to produce artificially full-load losses without the expenditure of full-load power.

AUTOMOBILE TEST.

In order to test the energy consumption of electric carriages under unfavorable conditions, a 100 kilometer (62 mile) test run was recently organized in Paris over dirty and slippery roads, fog prevailing at the time. A number of carriages carrying four passengers, and weighing complete over two tons, covered the entire distance at an average speed of nearly 15 miles an hour, and consumed less than 160 watt-hours per ton mile.

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EDITORIAL.

ELECTRICITY AND TRANSPORTATION

Even in this day of general and special information in science and engineering, there are many narrowly educated men who believe they know what they are talking about when they say that "electricity is in its infancy." To all these some one who really knows should shout, "It is not." "No one knows what electricity is," is a favorite remark among such wise ones. This is but partially true at best. Of all the forces of nature there is none so completely under control, none so accurately measured and none so easily adapted to every purpose as the so-called infant. Those who have striven hardest for its success know but too well what a sturdy giant electricity really is.

A little study of, and a few facts about, a recent electrical installation is of striking value in determining the real position electricity holds to-day in the world of transportation alone. The electrification of the Hudson River and Harlem divisions of the New York Central lines (New York City) has just been in part completed, and the system put in operation. The "Initial Electric Zone," extending from the Grand Central Station to High Bridge on the Hudson River division, and from the Grand Central Station to Wakefield on the Harlem division is now actually installed. The "Entire Electric Zone" is much greater in extent and includes from the Grand Central Station to South Croton on the Hudson River division and from the Grand Central Station to North White Plains on the Harlem division. The electrical installation and operation from High Bridge to South Croton and from Wakefield to North White Plains will be undertaken as soon as the Board of Railroad Commissioners approves the elimination of the grade crossings.

The complete installation for this work is very extensive. The initial capacity of the power stations, of which there are two, is 56,000 horsepower, there being eight 7,000-horsepower turbo generators. The ultimate capacity will be fifty per cent greater or 84,000 horsepower. The mileage in the "Initial Electric Zone" is eighty-five, but the total mileage when completed will be two hundred and ninety-two.

There are four sub-stations in operation, the capacity of the rotaries in each being 15,000 kilowatts, while the momentary capacity of the storage batteries is 22,000 kilowatts.

The ultimate equipment will consist of eight sub-stations, each having a normal capacity in rotaries of 27,000 kilowatts and a momentary storage battery capacity of 37,750 kilowatts.

The installed transmission system includes 12 miles of conduit and 6 miles of pole line, the weight of copper being 1,500,000 pounds. The completed system will consist of 16 miles of conduit and 46 miles of pole line, the two requiring 3,000,000 pounds of copper.

The complete installation will include ithrty-five 2,200-horsepower, 100-ton electric locomotives, and one hundred and twenty-five 400-horsepower, 53-ton motor cars for suburban service. The maximum speed of the electric locomotives will be between 40 and 80 miles per hour, depending upon the weight of the trains which will range from 250 to 900 tons.

The legislature of the State of New York authorized the New York Central and Hudson River Railroad to change the motive power from steam to electricity on May 7, 1903. The agreed date of completion of the change of motive power was July 1, 1908. The work was commenced August 17, 1903. The first experimental electric locomotive was operated October 27, 1904. The first electric train ran into the Grand Central Station, September 30, 1906. The work was, therefore, partly completed nearly two years before the anticipated date for the change in motive power as fixed by law.

Surely a 56,000-horsepower electric plant operating thirty-five 2,200-horsepower electric locomotives and one hundred and twenty-five 400-horsepower motor cars bears but little resemblance to an infant.

TRADE CATALOGUES.

A complete reprint of the paper on "Organization and Conduct of a New Business Department," by Mr. S. M. Kennedy of Los Angeles, has just been published in pamphlet form by the Co-operative Electrical Development Association of Cleveland, Ohio. This paper won the second of a series of prizes offered by the Electrical Development Association and the National Electric Light Association for ideas on business getting methods. It contains some very excellent suggestions of how the central station may not only get new business, but also how to effect an increased percentage in profit on the old.

In an artistically illustrated 24-page boolet, the Western Electric Company describes the character and some of the details of its Hawthorne Works, which are situated in the extreme western section of the city of Chicago. These works are comparatively new, for it is only five years since the company purchased the land upon which they are built. At present the works consist mainly of a pattern shop, pattern storage, foundry, forge shops, machine shops, cable and rubber plants, a gas plant, water tower, power plant, crematories, freight house, and round house for locomotives. The works are crossed by two railroad trunk lines providing switch connections, so that shipments can be handled with facility.

The architecture of the buildings and the interior arrangement and equipment of some of the machine shops are excellently shown by many large and clear cut photographs. One of these is of unusual interest, for it shows a direct current generator on the floor of the assembly room built to carry 10,000 amperes at 125 volts, running at 100 revolutions per minute.

The Western Electric Company, which has a branch office in San Francisco, has just published a little pamphlet telling how to unpack, trim and install arc lamps; also the care of the dash-pots, and the best way to clean the globes.

The Fort Wayne Electric Works, Fort Wayne, Ind., has devoted Bulletin No. 1,081 to Type A transformers. These are designed with interchangeable primaries for 1,050 or 2,100 volts, and may be had for capacities ranging from 6-10 to 50 kilowatts. They are especially suited to electric lighting purposes. The details of the arrangement, the windings, the core, the insulation, etc., are made clear by the accompanying photographs.

Bulletin No. 1,080 of the same company is devoted to engine-driven, multiphase generators. These are designed for direct connection, and are of the revolving field type. A description of suitable exciters is also included. Several excellent cuts show some of the generator units installed by this company.

Other recent bulletins of the Fort Wayne Electric Works:

Bulletin No. 1,082, describing an equipment for an alternating-current street arc lighting system.

Bulletin No. 1,083, devoted to Types M, A, and M. induction motors.

Bulletin No. 1,084, devoted to switch board panels for multiphase generators.

Bulletin No. 1,085, describing the Type K single-phase integrating wattmeter, together with the proper current and potential transformers.

A summary of the subject matter contained in the report of the Electric Railway Test Commission to the president of the Louisiana Purchase Exposition, is given in a pamphlet issued by the publishers, The McGraw Publishing Co., New York.

The Chicago Pneumatic Tool Company, Fisher Building, Chicago, has issued a 116-page catalogue, fully illustrated, on Franklin Air Compressors. The book contains several useful tables giving some of the specific properties of air.

THE FIREPROOF DYNAMO.*

The weak point in electrical machinery is almost always the insulation. It is true that the direct-current dynamo is somewhat handicapped by its commutator, but improved design has reduced the troubles at this point very greatly, and the commutator itself may be constructed so as to withstand a great deal of hard service. But both alternating and direct-current machines must employ some insulating material, and this is generally of necessity of such a character that it is seriously damaged, if not destroyed, by overheating. The commonest insulating materials are cotton and flax, which become carbonized at temperatures not much above that of boiling water, and they thus lose the very property for which they are used. In larger machines or those constructed for excessively high voltages the cotton insulation may be supplemented or even replaced by other materials, such as tubes or fiber or of mica. But fiber and even the cement used for building up tubes of small pieces of mica can not withstand indefinitely high temperatures, so that a form of construction which does not become too hot must be adopted. By means of various devices, such as ventilating systems or ways of arranging the materials of the machine, it is possible to dissipate a great deal more energy from a given weight of material or from a given surface than we could a few years ago. In this way we have succeeded in decreasing the weight and the cost of our apparatus, but we are not yet independent of temperature, for an overloaded machine will still become dangerously hot.

The difficulty encountered in insulating electrical machinery lies in the fact that a good electric insulator is also a good heat insulator, and the very process of construction employed to prevent the current from taking undesired paths is one well calculated to prevent the dissipation of heat, and therefore the inner layers of a winding of insulated wire in which energy is being dissipated as heat will be at a temperature considerably higher than that of the outer layers. One of the most successful means of combating this difficulty is the use of ventilating ducts, which cause a circulation of air through the machine. Another, of more recent date, also of very great importance in the construction of machines, is the use of strip windings. By this means a coil having a sufficient number of turns, with a conductor of the proper cross-section, may be made but one layer deep; and when this conductor is bare, as is very frequently the case, every foot of it is exposed to the air. This solution may be compared with the lamination of the armature core. A good path for heat conduction is provided, but a poor path for electrical conduction across from layer to layer, just as in the injury from overheating. The coils, after being wound, may be saturated with some insulating material and baked so as to convert them into a solid mass. This method of treatment has been employed in various ways, but has not come into general use for windings, and though of considerable value, this method would not make a machine entirely fireproof, for the insulation of the wire will eventually break down under the continued high heat, resulting possibly in a short-circuit.

Another method of insulation more recently tried makes use of the insulating property of aluminum oxide. This metal is used instead of copper, and is treated so as to take on a coating of oxide. The wire thus treated—otherwise bare—is wound up in coils without any other provision being made for insulation. For high voltage some precautions are necessary to secure a sufficiently thick coating of the oxide, but for ordinary voltages no treatment at all is required. The advantage of this method, beyond the reduction in cost which is said to result from it, will lie in the fact that the insulating coating is thin, and there is but little space not filled by the metal. If square wire be employed, as suggested, in some cases, the coil becomes almost a solid mass of metal and oxide. Such a coil is not only able to withstand fairly high temperatures, but should be a fairly good dissipator of heat, for although the insulating coating is itself a non-conductor, the fact that there is but little air space left between adjacent wires would facilitate the conduction and dissipation of heat. It is a question whether a coil wound in this way could stand very high temperatures, such, for example, as would drive off the water of crystallization of the oxide coating. Even should this happen, the pure oxide might be a fairly satisfactory insulator. The ideal construction is one which would enable the coils to be used even if red hot, although, of course, other considerations make it undesirable to work at such temperatures. The question of efficiency is on important one, and this is bound up in that of temperature.

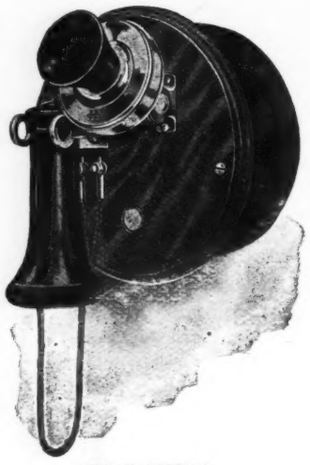
*From the Electrical Review (New York.)

INDUSTRIAL

NEW TYPES OF INTERIOR TELEPHONES.

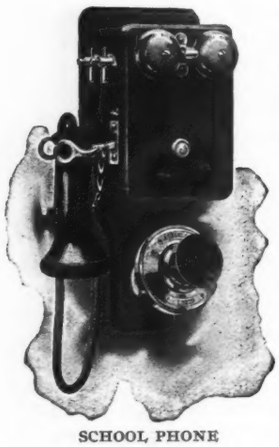
The accompanying illustrations show three new types of interior telephone instruments which have recently been placed on the market by The Holtzer-Cabot Electric Co., of Brookline, Mass., and Chicago, Ill. They are built along lines similar to other standard instruments manufactured by the above company, and yet are distinctly new in the combination of the different parts which enter into their make-up.

The single point circular flush wall telephone is designed for use in locations where space is somewhat limited and where an instrument that protrudes from the wall would not be desirable. The working parts are enclosed in a metal case 6 inches in diameter, which sets into the wall, allowing the face of the instrument to rest flush with the wall surface. The transmitter is of the solid back, granular carbon type, mounted on an adjustable bracket so that it may be used by persons of different heights. The receiver is of the standard bipolar, enclosed terminal type, mounted in a hard rubber shell. The face of the instrument may be finished in any one of a variety of woods which is best suited to the location where the instrument is to be installed. A flush push button for calling is mounted on the face, and if desired, a number of buttons may be added so that the instrument can be used in connection with others of a similar nature, making a complete interior telephone system. These instruments can be used in connection with the Ness automatic central, or may be used as branches of a telephone exchange.



WALL PHONE

The single point, school type of telephone is one of the latest types of telephone instruments brought out by the above company. It will be found especially adapted for use in schools, hospitals, and similar buildings. The equipment of the instrument is much the same as that of the flush telephone described above. An H-C solid back, granular carbon transmitter is used, mounted on adjustable bracket, and the receiver is of the bi-polar, enclosed terminal type, in hard rubber shell. Standard battery telephone bells are used, and a flush push button is provided for calling. A feature which has been added to this instrument is that of a chain connecting the receiver cord to the switch hook, so that if the receiver is accidentally left hanging, the contacts are closed, and the instrument is connected into circuit. Instruments of this type can be used with good efficiency in connection with Ness automatic central, or with a telephone annunciator. They may also be used in pairs if desired. The standard finish of these instruments is quartered oak, but they may be made to match the surroundings where they are to be installed.



SCHOOL PHONE

In hand microtelephones there is a unique combination of a bipolar, watch-case receiver and a granular carbon transmitter. The construction is such that when the receiver is held to the ear, the mouthpiece of the transmitter is in proper position for speaking. The handle, which is of hard rubber, contains a push button, which throws the batteries in or out of circuit at the will of the operator, thus prolonging the life of the batteries, as they are automatically cut out when the set is not in use. The instrument is solidly and durably built, and yet may be readily taken apart for inspection or adjustment. It is provided with a ring so that it may be hung up out of the way, and it is especially adapted for use as a desk instrument in connection with a local telephone exchange or as a branch instrument with the Ness automatic central, and, in fact, in all capacities in which a portable instrument can be used. These instruments may be provided with a metallic mouthpiece for the transmitter, when used where they will receive hard usage. The instrument is very neat in appearance, and conveniently light to handle, and should merit the approval of the users of telephone instruments in general.

HAND MICROTELEPHONE

Printed matter descriptive of the above telephone instruments may be obtained by writing the above company.

PROPOSED IMPROVEMENTS BY THE LOS ANGELES-PACIFIC RAILWAY.

It has been apparent for some time that the present equipment of the Los Angeles-Pacific Railway Company is insufficient to handle the constantly increasing traffic. The company now proposes to run two additional tracks along the greater portion of its double-tracked lines. Rights of way have already been secured between Vineyard and Venice, a distance of nine miles, and the necessary rights from Ocean Park to Santa Monica are assured. When these proposed improvements are completed, it is intended to run flyers to the beaches every seven and a half minutes. The middle tracks will be used exclusively by the flyers, the slower cars running on the outer tracks. The company has ordered 100 new cars, most of which will be equipped with four motors under unit control, aggregating 300 horsepower. About one-fourth of these will be used as trailers, as it is intended to operate cars in trains on excursion days. The work of excavating and preparing roadbeds has already commenced.

THE THIRD RAIL.

The third rail of the Long Island Railroad weighs 100 pounds per. running yard and is of rather higher conductivity than most conducting rails, being equivalent to 1,650,000 circ. mils of copper. It is also insulated with some proper regard of leakage, being supported every 10 ft. on vitrified clay insulators. The rail is housed in well supported planking, with additional protection at the stations. The bonding of these heavy rails involved some special difficulties, but was finally overcome by the use of laminated copper with terminals riveted into the base of the rail.

THE HOLOPHANE GLASS COMPANY'S ILLUSTRATED LECTURES.

The illustrated lectures which Mr. A. J. Marshall, illuminating engineer of the Holophane Glass Company, is giving before the central stations and gas companies on the question of light and illumination are proving very successful, and it is expected that this work will be the means of greatly assisting the growing demand for the best kind of lights properly placed for desired effects. Mr. Marshall lectured before the West Penn Electric Company, Connellsville, Pa., on Thursday evening, October 25th, at which an enthusiastic audience displayed great interest.

The Holophane Glass Company wishes to state in this connection that while this lecturing is planned out for some time ahead, they will, nevertheless, be pleased to consider application for this kind of work and deliver lectures in the order that requests are received.

POWER FOR THE BULLFROG MINING DISTRICT.

It is reported that the Nevada Power, Mining and Milling Company is about to extend its power system to the Bullfrog Mining District. This extension will be ninety miles long and will cost about $400,000. The present system was completed in September, 1905, at a cost of $600,000, and is 125 miles long. When this extension is built this company, which is made up of Denver capitalists, will be supplying power to all the new mining camps in Nevada, including Tonopah, Goldfield, Manhattan, Silver Peak and Bullfrog.

THE SOUDAN IRON MINE.

The earliest search for iron on the Vermillion Range and in Minnesota was in the vicinity of Tower and Soudan in 1861, but, because of the lack of transportation facilities, no development was possible until the present Duluth and Iron Range Railway, chartered in 1874, was completed in 1888, and the actual opening up of the district was accomplished. At the present time ore is being taken from a single shaft, on which 300 men are employed, where formerly there were thirteen shafts operated and 1,800 men were employed at one time. The two ore deposits now being worked are situated at the foot of the No. 8 vein and the Montana deposit, 800 feet distant from it.

The ore being produced is of a slate gray color, having unusual weight because of its high content of iron. Product from the Soudan runs nearly 67 per cent in iron, and is used principally in connection with open-hearth furnace practice.

With the completion of some contemplated extensions below the thirteenth level, the bottom of the shaft will have a vertical depth of 1,200 feet, which will be the deepest shaft in the State.

The Soudan surface equipment, which covers considerable ground, includes a power house and boiler house for the shaft hoists, engine rooms, repair shops, warehouses, etc.

The compressor plant is situated at some distance from the shaft in a place where water is available in order to operate the compressors condensing. The plant is installed in a building of brick construction 60x100 feet, and air is furnished from the compressors at 65 pounds in the mine. The machines are Allis-Chalmers duplex, cross-compound type with steam cylinders 18x36x48 inches and two stage air cylinders, 30x48x48 inches. Air pumps are the standard Allis type, belt-driven from the crank shaft. Each compressor has two vertical coolers.

The season's shipment for the Soudan mine is stated to be approximately 225,000 tons of ore.

News Notes.

TRANSMISSION.

Marysville, Cal.—Work has been commenced by the Bay Counties Power Company on its new concrete sub-station building at Fourth and Yuba streets. This is to be a large and modern building adapted in every way for the purposes it is intended to serve.

Beatty, Nev.—The New York Electric & Reduction Co., of New York, has purchased important water rights twenty miles north of this place. The company will build a large mill and reduction works to treat the Bullfrog, Goldfield and Tonopah ores. It will also build an electric power plant.

City of Mexico, Mex.—The Ocotes Mining and Milling Co. is preparing to install electric power.

Los Angeles, Cal.—The German Sausage Factory has been permitted to install an electric motor at 411 East Seventh street. The Los Angeles Engineering and Construction Co. is allowed an electric motor for its machine shop at 1519 East Seventh street. M. Sandburg has been granted a permit to operate electric motor at his basket factory, 125 Savannah street. The application for an electric motor and steam boiler made by Underhill Shirt Factory for 418 South Broadway has been denied.

City of Mexico, Mex.—Julio Pinal, of this city, Escobilleria, No. 1, has applied for a concession to utilize waters of Rio Octopa, in Vera Cruz, for motive power. Geronimo Fernandez has applied for waters of Rio de San Juan on his hacienda named Charcon, State of Queretaro. A contract has been entered into between Eng. Andres Aldasoro and Sr. Manuel Levi, authorizing Sr. Lazaro B. Caballero to install necessary hydraulic machinery to discharge 3,000 liters per second from the Realito de Tubares River, district of Andres del Rio, Chihuahua.

Prescott, Ariz.—The Octave Gold Mining Co. has discontinued its work on its mines at Octave for the purpose of installing heavier equipment and more powerful machinery. It is contemplated by the company to begin the erection of a large electric power plant at the railroad about ten miles distance from the camp, and to build a transmission line to the mine where electric pumps and a large electric hoist will be installed. Octave is about ten miles from Congress Junction, the nearest railroad station to which it is connected with a good wagon road.

City of Mexico, Mex.—E. L. Dewey has petitioned the department of Fomento for a concession to use waters from the river Tacambaro, State of Michoacan for the production of motor power. A. H. Woolrich, through his legal representative, Albert Stein, has secured concession for waters from Atoyac River, State of Oaxaca for motive power.

Reno, Nev.—The sum of $75,000 is to be spent by the Truckee River General Electric Co. for the development of the mineral interests of the State. The money to be used for the sending of electric power into sections that are without it.

Torreon, Mex.—A dam is to be built on the Hacienda Guattnape, owned by Juan Losaya, State of Durango, for irrigation purposes, and also for utilizing power, for which a lot of new machinery has been ordered. The engineering work will be in charge of Louis Alvarez, and the installation of machinery by F. D. Coats, of Tapona.

City of Mexico, Mex.—S. Pearson & Sons, Limited, have petitioned the department of Fomento for a concession granting them the use of waters of the River Antigua, State of Vera Cruz, for generating electrical power.

Lompoc, Cal.—An ordinance has been adopted by the town of Lompoc, granting to J. Kobloth, H. A. Heller and C. P. Baird, a franchise to erect and maintain poles, wires and

other conductors along certain public streets for the transmission of electricity for electric power and lighting system.

Santa Monica, Cal.—Sealed bids addressed to the President of the Board of Trustees are being received to furnish all labor and material and to construct a lighting system and furnish electric energy for the business block on Third street between Utah and Oregon avenues, Santa Monica, according to plans and specifications on file with the City Engineer.

Los Angeles, Cal.—The Board of Trustees of Los Angeles High School district is receiving sealed bids for the furnishing lights and fixtures for the various rooms in the Polytechnic High School Building, in accordance with specifications on file in office of the secretary of the Board, Chamber of Commerce Building.

Los Angeles, Cal.—A gas plant will be erected for the Beverly Hill subdivision, which is located between this city and Santa Monica, and is being put upon the market by Percy H. Clark Co.

Lompoc, Cal.—The Lompoc Light & Power Co. will commence the erection of its power house in a few days . It will be 60x30 feet of infusorial rock, and will be located near the big mill and warehouse now being erected by the Magne-Silica Company.

San Francisco, Cal.—The United Railroads has completed its plans for the restoration of the Powell and Sacramento cable systems, and expects to go to work shortly on the Washington and Mason streets power station, destroyed by the fire.

Los Angeles, Cal.—An ordinance has been adopted providing for the furnishing of electric current and for the lighting of Spring street from Temple to Ninth, and Main street from Ninth to the east line of Broadway.

Monterey, Mex.—The stockholders of the Cia. Industrial Jabonera de la Laguna, S. A., which operates a large soda factory six kilometers from the city of Torreen, will construct a reservoir with capacity of two million gallons, and also put in a great number of gas producers. Francisco Belden of Monterey is one of the members of the company.

Riverside, Cal.—Citizens of San Jacinto are contemplating forming a home company and supplying the city with gas.

INCORPORATIONS.

Los Angeles, Cal.—The Central California Gas and Electric Company has filed articles of incorporation here, the capital stock being $150,000, and the incorporators being Samuel Mock, G. L. Weinberg, Moses Greenwald, Adolph Gensler and S. Magnies.

Los Angeles, Cal.—The Hyde Park Water Company has filed articles here, the capital stock being $10,000, and the incorporators: F. Simonds, F. Paramore, J. H. Nelson, P. McAneney and A. P. Green.

San Francisco.—The Western Electric Company has been re-incorporated here, the capital stock being increased from $5,000 to $100,000.

Los Angeles, Cal.—The Brown-Janvier Reservoir and Water Company has been incorporated here with a capital stock of $2,400, by Emily Brown, Louisa Janvier, Jeanne Dennen, L. Moutrie and John Marlin.

Los Angeles, Cal.—The Bilboa Heights Land and Water Company has been incorporated here with a capital stock of $50,000, by F. F. Johnson, G. C. Chandler, J. M. Fletcher, J. F. Digmun and E. Chase.

The Western Power Company has been incorporated by John Krischwing, of Spokane, and his associates, with a capital of $500,000. The company is empowered to buy patents and patent rights pertaining to current, motors and inventions appertaining to the development of power by current.

Bakersfield, Cal.—The National Gypsum and Oil Company of Los Angeles has filed its articles here with a capital stock of $25,000 and shares of $100 each. The directors are B. F. Roy and A. A. Hopkins, A. and J. A. Hardesty, all of Los Angeles.

ELECTRIC RAILWAYS.

Boise, Idaho.—It is reported that the Boise & Interurban Company's line will be ready to operate on February 1, 1907.

Edmonton, Alta.—The Commissioners are considering a municipal street car system to cost $100,000.

Moscow, Idaho.—W. T. Zimmerman of Spokane, states the Spokane & Inland Empire Railway will build into Lewiston from this place.

Nampa, Idaho.—W. E. Pierce and associates of Boise, have been granted a franchise to build an electric railway on certain streets of the city. T. H. Knox is chief engineer.

Prince Albert, Sask.—The Prince Albert Street Railway Company has applied to the City Council for a twenty years' franchise. The company agrees to spend $80,000 on the plant, track and cars within three years.

Seattle, Wash.—The Seattle Electric Company was granted permits to lay double tracks on East Union street, between Twenty-fifth and Twenty-sixth avenues, and on Denny way between Western and First avenues.

Dawson, Y. T.—The United States Government is considering the building of a three span bridge across the Yukon river, above the Rampart rapids. The proposed bridge is to be a part of the overland trunk road that is to connect Fairbanks with Nome.

Reno, Nev.—Victor H. Woods, Surveyor-General of California, is generally believed here to be the financial promoter of an electric railroad which will be constructed from Sacramento to Lake Tahoe, with a terminus at Tallac. The route has been surveyed, and leads past Placerville and up the American River. A line is already financed by James May of this city, from Reno to Lake Tahoe. This will connect with the Sacramento line if the plans of Woods and his associates materialize, and a thorough run may be made from Sacramento to Reno, in about six hours.

Palo Alto, Cal.—Two petitions, one from the Political Equality Club and another from property holders along Emerson street and Hawthorne avenue, and a large number of protesting citizens have been unable to influence the town trustees to rescind their action granting a permit to the Hanchett Company to lay a track along the streets named. The Board approved the minutes of the former meeting after modifying the permit by providing that in the event of the railroad company building a subway under the Southern Pacific track to get an outlet to the county road, it shall make the subway the full width of the street and open it as a public thoroughfare.

San Francisco, Cal.—The Parkside Transit Company, organized by the Crocker and other interests of the Parkside Realty Company here, have made a preliminary petition to the Supervisors for a twenty-five-year franchise to construct and operate a street car system over the following route: From the juncture of Ocean and Corbett avenues through private ground to Nineteenth avenue and crossing the latter, in a westerly direction to what would be the line of Market street extended; along Market street's western terminus; thence through private ground northwest to the Great Highway. Also along portions of W, V, and T streets and Thirty-third, Thirty-fifth and Forty-sixth avenues. Also along Nineteenth avenue from H street to its southern terminus. The company petitions for a permit to lay temporary tracks for development work over the same routes.

FINANCIAL.

San Francisco.—A special meeting of the Central California Power Company will be held December 27th, at room 801 Kohl Building, San Francisco, to consider the creation of bonded indebtedness of $5,000,000 to use in constructing and completing the company's power houses, diversion and restraining dams, flumes, ditches, pipe lines, pressure pipes, transmission lines and reservoirs.

San Francisco.—The Standard Oil Company of Iowa has transferred all of its holdings in this State to the Standard Oil Company of California. It embraced assets of all kinds connected with the business of the former company, which has been running for almost twenty years in this State. Among them are the big plant at Seventh and Irwin streets, besides a vast amount of real property and paraphenalia scattered all over California, from San Francisco to Los Angeles. The consideration of many millions said to have benn paid, is one of the secrets of the Standard Oil Company. By many financiers it is suggested that matters not foreign to the Federal Courts may have rendered it advisable for the Iowa concern to pass out of existence, and merge its business and holdings in that of the Standard Oil Co. of California. Others seem to think that a desire to curtail expenses of operation and simplify matters generally is the reason. W. S. Miller, Treasurer of the California Company, says: "The Standard Oil Company of Iowa was incorporated under the laws of Iowa in 1885. It was a separate and distinct organization, as are the other Standard Oil Companies. I do not know that the Iowa Company ever did any business in Iowa; in fact, I am positive it did not, merely having offices there for the purpose of holding a yearly meeting. It has been doing business in California over fifteen years, and was the only Standard Oil Company here until a little over a year ago, when the Standard Oil Company of California was formed.

Phoeniz, Ariz.—A long step has been taken toward the acquirement by the city of of the Phoenix Water Company's plant. General Sherman has agreed to sell it to the city for $150,000. Congress will be asked to authorize the city to make use of the proceeds of the present bonds. This will close up the litigation at Cincinnati over the bonds, which are tied up there by an injunction issued on the application of General Sherman last summer.

Fullerton, Cal.—There is talk of forming a local gas company in Fullerton, to install a complete system here at once. The proposition is to incorporate for $20,000 and raise about $18,000 of the stock here. Mr. Willits of Orange holds a gas franchise here and offers to put $2,000 in the enterprise.

San Francisco, Cal.—A monthly dividend, No. 32, of five cents per share on the issued capital stock of the Northern California Power Company has been declared, payable October 25th, by mailed check.

San Pedro, Cal.—At the last meeting of the Board of the city of Wilmington, the matter of constructing a city light and water plant through the issuance of $200,000 or $300,000 worth of bonds, was considered.

Bakersfield, Cal.—At the annual meeting of the stockholders of the Twenty-eighth Oil Company, October 8th, the following officers were re-elected: President, Turman G. Hart; vice-president, L. L. Cory; secretary, Jacob Clarke. Directors—Sam Shannon and Frank H. Short; superintendent and financial agent, Sam Shannon. Out of the 60,000 shares, 50,000 were represented. The annual statement to the stockholders was issued, showing, in addition to the usual reports, a full financial account of the company since its formation six years ago. Dividends to the amount of $240,000, or $4 a share, have been paid, in that time.

ILLUMINATION.

Coahuila, Mex.—This place will shortly have an electric light system. A company composed of prominent citizens has been formed to establish an electric lighting plant, and it is proposed to establish an electric street car system.

Porterville, Cal.—The City Trustees have granted permission to A. Gonslien to install a gas plant and lay pipes. The company will incorporate under the name of the Central California Gas Circuit Co., with a capital of $150,000.

Mountain View, Cal.—The Mountain View Gas and Electric Company has bought lots 1, 2 and 3 in block 2, Meckbee and Wielheimer Addition, a location for the new plant on which construction will begin at once.

Pasadena, Cal.—Bids have been opened by the City Council for machinery for the proposed municipal electric light plant. The Charles C. Moore Co., of Los Angeles, for plant complete, bid $36,000. Other bids were from the American Diesel Engine Co., of New York, $18,250; and the Baker Iron Works of Los Angeles, $21,150; both of these latter bids being for part of the equipment. Later, the City Council accepted the bid of Charles C. Moore & Co. The City Clerk has been instructed to advertise for bids for necessary poles, lamps, and wires, such bids to be in by Tuesday, November 13th. As soon as the machinery is ready the engine house will be ready to receive it.

Perris, Cal.—R. J. Dunn, of Redlands, was in town last week looking over the field for a prospective gas plant to be erected by himself and associates. It is proposed to erect a $10,000 plant here. Definite plans are to be arranged in a few days.

Yuma, Ariz.—The City Council is to study the proposed franchise which is desired by Seth Hartley, of Colton, Cal., for establishment of a gas plant in Yuma. Two more weeks will be spent in investigation.

Long Beach, Cal.—By order of the City Trustees, Attorney Daly is preparing a resolution calling for estimates and plans for a municipal lighting plant.

Oakland, Cal.—A large gas main along Eighth street exploded last week. A trench had been dug by the Home Telephone Company, and one of the workmen had accidentally knocked a hole in the gas pipe. The escaping gas was ignited later, and in a second, there was a roaring column of flame shooting into the air forty feet high. A still alarm was turned in, and the firemen vainly sought to extinguish the flames, as they were apprehensive that they would set fire to the buildings in the neighborhood. The blaze, however, was not extinguished until the gas supply was shut off temporarily.

Santa Rosa, Cal.—Stephen Gambal, superintendent of the municipal lighting plant at Sebastopol, was nearly electrocuted a few days ago at Sebastopol. He received 2,250 volts of electricity, touching the wires carrying the current with his head, as he rose beneath them. He was alone when he touched the wires, and even though he has regained consciousness, after many hours, he can give no idea of how the accident happened.

Los Angeles, Cal.—Newport Beach is to have gas and electricity. There are three different companies who want the contract for furnishing the lights.

WATERWORKS.

Pasadena, Cal.—The City Council has voted to abandon entirely all proceedings in connection with procuring a municipal water system for the city by buying present plants and an entirely new start will be made.

Porterville, Cal.—At the meeting of the stockholders of the Cape de Ore Water Co. it was decided to replace the present No. 2 Ames pump with a No. 4, to put in steel pipes in place of the Redwood pipe, and other improvements in order to supply 60 inches of water instead of 40.

Oakland, Cal.—A municipal water plant of tiny dimensions has been ordered by the Board of Public Works to make provisions for the need of Bushrod Park. The City Council recently allowed the expenditure of $10,000 of the Park and Boulevard funds for the improvement of the grounds, and the Board authorized $2,100 in the installation of a tank and tower, a motor and pipes for the new water works.

Huntington Beach, Cal.—The Huntington Beach Co. is to build a reservoir on Signal Hill. A 12-inch pipe is to connect the reservoir with the pumping station. Manager Reed is making an approximate estimate of pipe necessary for connections and extensions.

Los Angeles, Cal.—The Berkshire Hill tract in the Eagle Rock Valley, being put on the market by the Berkshire Hill Co., will conserve the Eagle Rock mineral water in a reservoir on Sagamore Hill, which will be piped to all lots of the tract.

TELEPHONES AND TELEGRAPH.

Bend, Ohio.—The Deschutes Telephone Company has purchased the line between Pineville and O'Neil.

Coeur d'Alene, Idaho.—The Rocky Mountain Bell Telephone Company is adding two more direct lines from Spokane to this city, and also one to Sandpoint.

Everett, Wash.—The headquarters of the Farmers' Mutual Telephone Company has been moved to this place from Snohomish.

Olympia, Wash.—A new rural telephone line is being built along Chambers lake to connect with the main line near the Boulevard road.

Seattle, Wash.—Instruments are being installed at the Great Northern relay telegraph office in the Union station, which will give a "quad" service on the through wire from the general offices to the railroad in Seattle, to the general offices in St. Paul.

Seattle, Wash.—Branch telegraph offices are to be opened by the Western Union Telegraph Company in the Pike street district and the wholesale section in the course of a month or two, according to Frank Jaynes, General Superintendent.

Sumas, Wash.—The Postal Telegraph Company will immediately repair its line between here and Sedro Woolley.

Spokane, Wash.—Architect Albert Held is receiving bids for the construction of the Home Telephone building on Howard street, between Railway and Second. The building is to be of reinforced concrete, 72x100 feet, three stories, and will cost $75,000.

Grass Valley, Cal.—It is expected that within six weeks about sixty farmers will be connected with this city by telephones. F. W. Bennett, the Sunset promoter, is interviewing outlying districts. Much encouragement is being met with.

Riverside, Cal.—Telephones and telegraph companies will be requested to put their wires under ground in business parts of the city in order to make possible the installing of a system of ornamental cluster lights similar to those used in Los Angeles and Pasadena.

San Francisco, Cal.—Welcome I. Capen, who has been appointed general superintendent of the Western division of the Postal Telegraph-Cable Company, was superintendent of the Chicago district when promoted. He succeeds E. J. Nally, who recently has been elected a vice-president of the company. Mr. Capen's headquarters will be in Chicago, and he will have charge of all of the lines west of there. He was born in Brattleboro, Vt. in 1854, and began his career as a messenger. His first promotion from the key was as manager at Baltimore for the Automatic Telegraph Company, and then he became wire chief for the Western Union and manager of the Cincinnati, Baltimore and Ohio Telegraph Company. In 1880 Mr. Capen was appointed manager of the Postal at Cincinnati. Subsequently he was made superintendent at Indianapolis, and in 1899 he same to Chicago as local superintendent.

Spokane, Wash.—H. A. Phelps, President anl Treasurer of the Interstate Telephone Company, announces that the $400,000 added to the capital stock of $100,000, will be used in building operations in Spokane, the completion of the exchange at Coeur d'Alene, Ida., the building of the extension to Wallace, Ida., and the completion of the toll line into Spokane. The last named line is now within one mile of Spokane. One hundred thousand dollars of the increased capital of $400,000 was subscribed at the meeting on the evening of November 2d, when the stockholders expressed themselves in favor of pushing plans for the invasion of territory in Oregon and Idaho, as well as Eastern Washington.

Spokane, Wash.—The Empire Construction Company began work on the Home Telephone Company's lines November 5th, and it is given out that work will be pushed. The company has 3,000 poles in the yards ready for installation in the outskirts of the city. The wires in the business districts will be put underground. Contracts for the excavation of the home building in Howard street, to cost $60,000, have been awarded, and it is expected that work on the foundation will begin early in December, the purpose being to have the structure completed in May, 1907. The main building will be 71x100 feet, three stories and a full basement. The building will be of re-enforced concrete with terra cotta trimmings. Albert Held is the architect.

Spokane, Wash.—Manager Van Dyke of the Rocky Mountain Bell Telephone Company, announces that another wire will be strung between Spokane and Wallace, Ida., seventy miles, and that it will be in operation inside of thirty days. It will be used chiefly by business houses and brokers, the last named finding they can get better service than by the use of the telegraphs.

Spokane, Wash.—The forthcoming directory at Walla Walla, Wash., which was a waste of sage brush only a few years ago, will show 2,500 patrons for the Pacific States Telephone and Telegraph Company, the increase in the last eight months being a little more than 20 per cent. Manager McGillibray announces that all rural lines out of Walla Walla have made connections with the Pacific States lines.

Spokane, Wash.—The Farmers' United Telephone and Telegraph Company, financed by Walter and Albert Higgs and Anton Kramer of St. Andrews, Wash., has asked the Commissioners of Douglas County for a franchise to build a line from Coulec City, one hundred miles north and northwest, to enter the towns of St. Andrews, Jean, Mansfield, Bridgeport, Hold and Heahy. If the farmers' lines join the company will have a complete service by independent phones reaching all over Douglas County.

Spokane, Wash.—James A. Allen, a grocer at Wallace, Idaho, east of Spokane, lost a bunch of money a couple of days ago because of delay in getting connections with a jobbing house in Spokane. He put in the call early in the morning, the purpose being to place an order for 30,000 pounds of sugar. Though he tried at least a score of times during the day to have the Rocky Mountain Bell Company get Spokane, the operator was unable to make connections until late in the afternoon, when Mr. Allen was advised by his dealer that the price had advanced 10 cents a hundred pounds.

Madera, Cal.—The Sunset Telephone Company will soon erect a telephone line between this place and Raymond.

Lodi, Cal.—A long-distance telephone line will at once be put in between Lodi and Stockton, and Lodi and Sacramento.

Redding, Cal.—Wires and poles have been ordered for the rural telephone company's system, which will connect with the Redding Central. The officers of the new corporation are D. W. Hampton, president; J. B. Martin, secretary. It is called the Pacheco Telephone Company.

Spokane, Wash.—Farmers at Oakesdale, south of Spokane, rejected a proposition to join the rural lines with the Pacific States Telephone & Telegraph Company a few days ago, and this resolution is now being generally circulated:

"We, the undersigned subscribers and owners of the rural telephone lines centering in Oakesdale, do hereby agree that we will not enter into any contract with any long distance telephone company."

Representatives of the Northern, North Steptoe, Doneen and Spring Valley lines have already signed and scores of names are being added to the list. Representatives of the company are going through the country, but there appears to be no hope for the merger at present.

J. E. Lawrence, manager of contracts for the Home Telephone Company, is in Spokane looking after contracts. He announced that the system will be in working order early next spring.

Palouse, Wash.—South of Spokane, with nine rural telephone lines, has been the center of an interesting fight between the Pacific States Telephone & Telegraph Company and the Interstate Co-operative Telephone Company for more than a year, the result being that the business is split. The switching the first three months will be done in the Pacific States office and the next three months in the Interstate, and so alternating throughout the year.

The Interstate Co-operative Telephone Company has been handicapped by lack of facilities, but expects a new switchboard early in November, and will then establish a twenty-four hour service, and make a fight for city business. Connection with Spokane is promised within a few months, as is also a service superior to that of the Pacific States.

Increasing its capital stock from $20,000 to $100,000, the Interstate Telephone Company has amended its articles of incorporation just filed with the Secretary of State. The company, which is organized to transact a general telephone business in Washington, Oregon, Idaho and Montana, has a system in operation in Northern Idaho, and N. A. Phelps, President, said in Spokane a short time ago that the stockholders have approved a proposition to extend the line.

The Rocky Mountain Bell Telephone Company is extending two direct lines from Spokane to Coeur d'Alene, Idaho, and another to Sandpoint, Idaho, also numerous small toll lines. The work is being retarded by the scarcity of electricians and wiremen.

TRANSPORTATION.

San Francisco, Cal.—The special committee of the Supervisors appointed to ascertain from the United Railroads officials what steps the company was taking to relieve the shortage of street cars, had a conference recently. Supervisors Wilson, Sanderson and Boxton were assured by Assistant-President Mullally and General Manager Chapman that the road would strive to better the conditions of travel. In addition to the sixty-two new cars now here, thirty-two of which are already in service, the company has 250 more, and expects 100 of these by January 1st. The company will spend $1,500,000 for new cars. The officials also expect to erect large car barns near Ingleside at a cost of $240,000.

San Francisco, Cal.—It is officially stated by officials of the California street system that cars will be running to Jones and Market streets and to O'Farrell and Market streets by December 1st. Scarcity of rolling stock is all that is checking the operation of the line. The road is in fairly good condition, and it will require but little time to have it in such shape that cars can be run over those streets that will give central Market street a better means of communication.

Redlands, Cal.—The San Bernardino Valley Traction Co. has been granted a franchise by the City Council of San Bernardino to double track its lines operating in that city. The sum of $500 was paid for the right. Another double track franchise was sold in Colton for double tracking the company's line.

Colton, Cal.—At an adjourned meeting of the Board of Trustees held for the purpose of opening bids and selling a street car franchise, Dan Johnson, being the only bidder, the franchise was sold to him for $25. A. G. Denman filed application for a franchise for an electric railroad down Eight street from J to Congress.

City of Mexico, Mex.—The new Electric Railroad to be installed in Guadalajara will use entirely Americal material, already ordered. The United States Steel Corporation supplies the rails, the General Electric Co. the electric plant, and the cars will be furnished by car manufacturers of New York. The system will cost about $1,500,000.

Torreen, Mex.—Several Chinese residents of Torreen are planning to ask a concession from the State Government for the construction of a street car line in this city.

Los Angeles, Cal.—In addition to the activities in the direction of Hollywood, there is contemplated an extension of the West Temple street line, the construction of a line from Azuza into the mouth of the San Gabriel Canon, the continuation of the trunk line through Covina on to Pomona, reaching Riverside, and the construction of the promised line from Orange to Santa Ana and from thence to Newport.

Redlands, Cal.—The Board of Trustees of the city of Redlands will receive up to the 23rd of November sealed bids for an electric railroad franchise applied for by A. G. Hubbard.

Redlands, Cal.—The Board of Trustees of the city of Redlands will receive up to the 23rd of November, sealed bids for an electric railroad franchise applied for by N. Buckmaster.

Santa Monica, Cal.—As soon as laborers can be secured the Los Angeles-Pacific line will make extensive improvements and an extension to its north loop division in Santa Monica. The double tracking of the road will be continued northward on Third street.

Pasadena, Cal.—The Pasadena Park Improvement Co. submitted a bid of $100 for a franchise for an electric railroad on East Orange Grove avene from Lake avenue to the city limits, and the Council accepted the proposition.

Los Angeles, Cal.—It is expected that active work will begin in the near future on the street car line franchise acquired by Mr. Walsh, of the Wilcox Building, for an Eastern syndicate. The line is to begin at the intersection of Broadway and West Seventh street, eastward to Los Angeles River, to be spanned with a steel bridge, to Boyle avenue, etc.

San Bernardino, Cal.—The Board of Trustees have sold a street car franchise to Dan Johnson for $25.

POWER AND LIGHT PLANTS.

Dawson, Y. T.—The Canadian Westinghouse Co., Hamilton, Ont., has been awarded the contract to build electrical machinery for the Goldfields Company.

Dewey, Idaho.—The Trade Dollar Consolidated Mining Co. will expend $100,000 in enlarging its plant at Swan Falls. Four turbines direct connected to generators will be installed, increasing the capacity of the plant about 2,000 horse-power. An addition will be built to the power house 30x130 feet. Frederick Erwin, manager.

Meadows, Idaho.—C. W. Duck, engineer of Idaho City, is making surveys for an electric power plant which is to be erected here.

Point Richmond, Cal.—The Great Western Power Co. has been incorporated with a capital of $25,000,000 by Guy C. Earl and W. H. Spaulding of Oakland, H. K. Young, E. A. Grove, W. Stairley and L. D. Dimm of this place, F. D. Madison of San Rafael and B. C. Carroll of San Francisco.

Sheridan, Wyo.—The Sheridan Electric Light & Power Co. is contemplating the erecteion of an addition to its power plant.

Sumas, Wash.—The Stave River Power Company contemplates extending its lines to Kendall; also the erection of a transmission line from Vancouver to Sumas, Prairie and Shiliwack.

Sand Point, Idaho.—The Sand Point Citizens' Water, Light & Power Company is reported incorporated with a capital of $150,000, by George Heaton and Robert. Coons.

San Francisco, Cal.—The California-Nevada Canal, Water & Power Company has been incorporated here with a capital of $2,000,000 by L. H. Sussman, J. Haber, Jr., and W. J. McLeon, of this city and Charles Elsey of Oakland and Joseph C. Love of Berkeley.

Gordon Falls City Manufacturing, Power & Light Company, $175,000; Sigmund Sichel, Henry Hewett and R. W. Wilbur, Portland.

Los Angeles, Cal.—Contracts have been closed between the Desert Power and Water Company and the Gold Road Mining and Exploration Company for an oil-actuated electric power plant, capable of generating 2,200 horsepower, to be built at Kingman, Ariz. Ground for the plant will be broken within thirty days at Kingman. California oil will be used for fuel.

Goldfield, Nevada.—The Frances Mohawk lease on Mohawk No. 2, under the management of Manager McKay, will increase the number of machine drills within a short time, and a new 50-horsepower electric hoist and cage will be installed at an early date.

Marysville, Cal.—One man was killed and two are believed to be fatally burned by electricity, as the result of an accident on the main line of the Bay Counties Power Company, near Nicolaus, October 19th. Thomas R. Lee of Smartsville is dead, and the injured are Frank Cunningham, of Byron, Contra Costa County, and T. J. Mundy, of Philadelphia, who were badly burned. Lee was a teamster for a construction gang, and was holding a wire while two linemen made a splice. The line was dead when they began working, but the current was either switched on or an accidental contact was made while they were working, for all three were suddenly enveloped in flame, and were picked up for dead. Five doctors were summoned from Nicolaus, Wheatland, Davisville and Sacramento and did everything possible for the men. They hold out hope for the recovery of Cunningham and Mundy, but Lee died instantly. The injured men were taken to a Sacramento hospital.

Oroville, Cal.—Within the next three years, $5,500,000 will be expended here in the development of the Big Bend proposition. At this time, and for some time past, men have been in the field, and work is now being pushed with all the rapidity possible.

Marysville, Cal.—The Marysville and Nevada Water and Power Company, that has expended about $100,000 on its properties in this and Nevada Counties, is preparing to develop them. It has purchased the land and water rights along the North Yuba and Bear Rivers, and has driven a tunnel that will be used to convey the water from a dam below Alabama Bar to a ditch that will carry it to Bullard's Bar. Power houses will be located at Alabama Bar, Bullard's Bar, and Dry Creek, that will have a combined capacity of 41,886 horsepower. The company will develop three large water rights by building dams to divert the water into canals. All of the property and rights have been secured for the lower dam, which will be at the narrows above the Parks Bar bridge, including a rock quarry that will provide material for the construction of the dam. There have been filed for record a number of deeds that have an important bearing upon this matter. These deeds are for land and mining claims.

Salt Lake City, Utah.—W. B. Abertson of Salt Lake City has made application to the State Engineer for water rights to a flow of forty second feet from Cottonwood Creek. The diverting work will consist of an earthen dam, etc., which will develop a total of 3,500 horsepower, which will be used in operating machinery and an electric light plant in Salt Lake Valley.

The Chelan Electric Company, of which J. T. McChesney of Everett, Wash., is president, has acquired riparian rights on the Chelan river, between Chelan and Chelan Falls, west of Spokane, and will erect a power plant for the operation of an electric railroad from the town of Wenatchee, northward along the Columbia River, with a branch to Lake Chelan, and up the Okanogan River to the northern boundary of the State. The power will also be utilized in supplying the town of Chelan with electric lights and water and in lighting the towns of Wenatchee, Waterville, Orondo, Brewster and points along the Columbia River, also pump water for irrigating purposes from the Columbia River onto the available benches along the stream, and for the purpose of operating the line of the Great Northern from Wenatchee to Seattle, a distance of sixteen miles, and for lighting the various towns along the way.

Salt Lake City, Utah.—John Glenn of Vernal has made application for four second-feet of water to be diverted from Wilson Creek, and for a flow of fourteen second-feet to be diverted from Dry Gulch Creek.

City of Mexico, Mex.—The Schoendubs and Neugebauer Company has obtained a concession to execute work necessary to utilize 10,000 liters of water per second from the Conchos River, in the Iturbide district, State of Chihuahua. Aerial or subterranean lines may be used for transmitting electric power.

Spokane, Wash.—The Skykomish Power Company has begun condemnation proceedings against a number of land owners along the Skykomish River, west of Spokane, where it intends to erect a power plant to cost $750,000, also a pulp, sulphide and paper mill, which will cost $1,000,000, and employ six hundred persons. It is purposed to bring the power from a dam at Canyon Falls. The company also purposes building an electric line to tap a number of lumber camps and connect with the main line of the Great Northern. A representative of the company said in Spokane that the mill will turn out 70 tons of paper a day and at a cost $15 a ton cheaper than at present. The company has been incorporated in Washington with a named capital of $2,000,000.

The Washington Water Power Company is to run a new power transmission line to the Coeur d'Alene mining district from its plant at Post Falls, Ida., east of Spokane, the estimated cost being $500,000. It will furnish from 16,000 to 20,000 horse power for the mines and mills. D. L. Huntington, manager of the company, said in Spokane that there has been so much activity in the mining district that another line is needed. He added: "We expect the demand to still increase and we are preparing for it. Work will begin next spring."

The Washington Water Power Company's lines have reached Palouse, Wash., south of Spokane, carrying 60,000 volts, stepped down by transformers to 2,300. Nineteen thousand dollars will be expended in the sub-station at Palouse, which is the terminus of the line from Spokane. A twenty-four-hour service will be run.

N. C. Grover, Assistant Chief Hydrographer for Washington and Oregon, said in Spokane a few days ago: "Enough power is wasted every year in Washington and Oregon, which, if developed, would make these States economic factors in the history of the country. To neglect such an opportunity as is presented in Eastern and Central Washington is certainly detrimental to the best interests of the State."

OIL.

Los Nietos, Cal.—The Central Oil Company's losses by the late fire included two tank cars filled with crude oil, a pump house and its machinery, a leading rack and about 300 feet of side track.

Santa Barbara, Cal.—Claude Loveday, the local electrician, has the contract for installing new generators and motors at the Alcatraz refinery at Alcatraz, which is owned by the Associated Oil Co. The oil company is now handling nearly 200 barrels of the oil daily at Alcatraz. It is expected that the refinery will be able to double its capacity within a few months.

GOVERNMENT.

Washington, D. C.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, until November 13th, to furnish at the navy yard, Puget Sound, Wash., naval supplies as follows: Sch. 220: Generating sets and spare parts, gun-elevating and turret-turning motor generators. Sch. 221: Oak.